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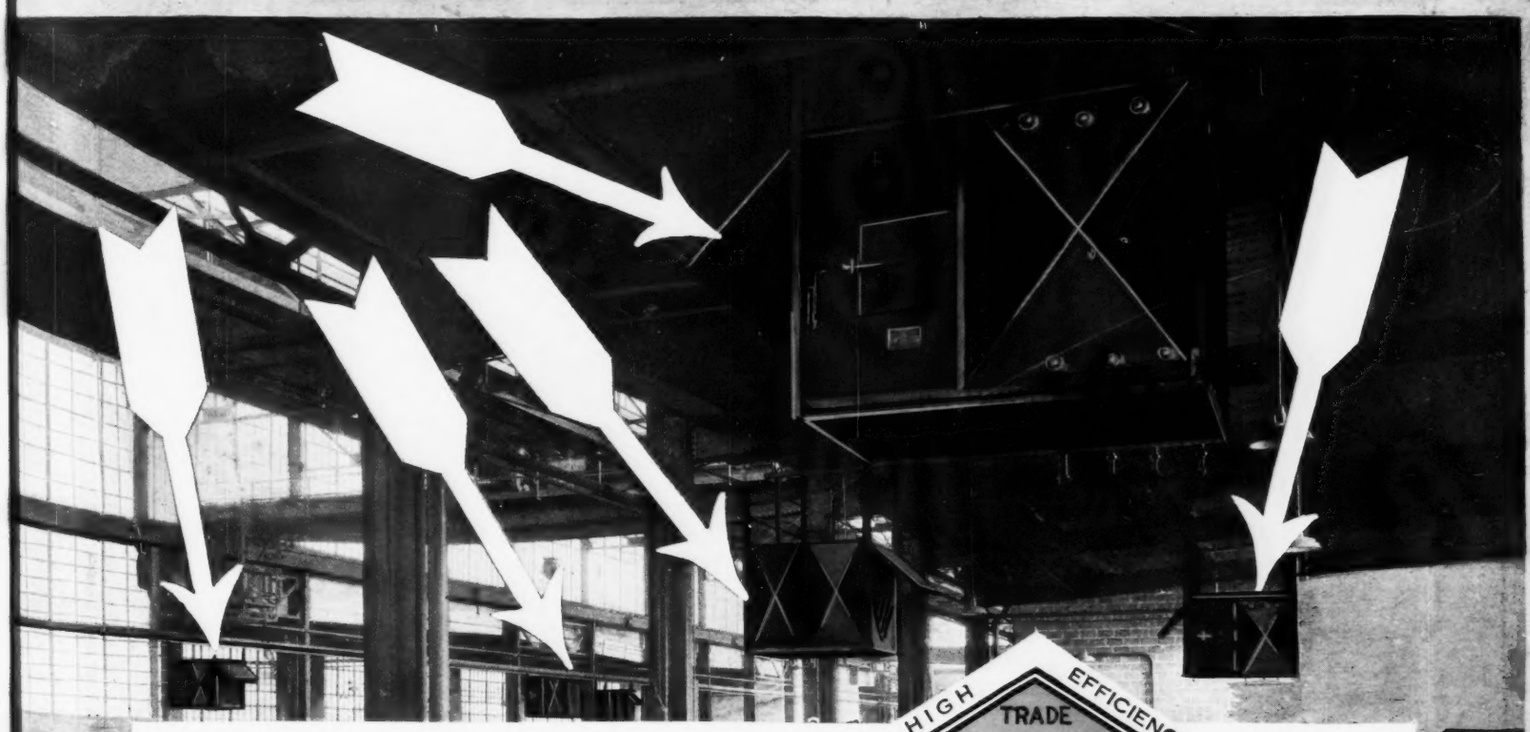

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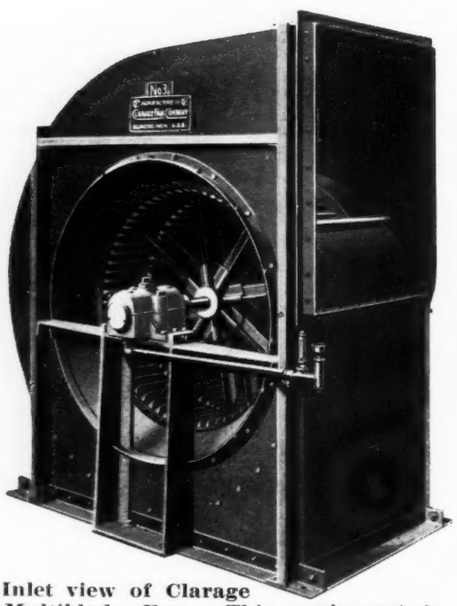

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How They Heat With Fuel Oil On The Pacific Coast

Notes on Present Practice in a Section of the Country Where Oil-Burning Has Long Been Successfully Applied

By C. W. Wright

FUEL oils on the Pacific Coast average 16° to 18° Baumé, the fuel-oils from the mid-continent section run between 22° and 30° Baumé, while, on the Atlantic seaboard, the Mexican fuel-oil runs about 12° to 14° Baumé. The heat value varies from 18,000 to 20,000 B. T. U. per pound. The lighter the oil the higher the heat value per pound. Oil averaging 20,000 B. T. U. will weigh about 7.5 lbs. per gallon, while the 18,000 B. T. U. oil weighs about 8.1 per gallon.

Efficient combustion is measured by the per cent. of CO_2 in the combustion gas and should average above 12% to 14%. With this combustion we get a temperature of over 3000° F. in the combustion gases. The fire should be of a pale yellow or orange color. This efficiency of over 97% which, combined with a good clean boiler of good circulating construction and efficiency, would give a combined efficiency of at least 80%.

Steam at 5 lbs. pressure requires practically 1000 B. T. U., so for every pound of oil consumed we should get 80% of 18,000 B. T. U., or 14.4 lbs. of water evaporated into steam. This is with feed water at 212° F.

The foregoing data and figures, which are supplied by the Bunting Iron Works, of San Francisco, California, are considered conservative as tests have shown 83° combined efficiency and an equivalent evaporation of 15.6 lbs. of steam per pound of oil consumed. If too much air is admitted into the combustion, the CO_2 reading drops to 7% or 8% and the temperature of the combustion correspondingly drops down near 2000° F. This type of fire will be shown in the dazzling white combustion similar to a Tungsten electric lamp and is a condition to be avoided. It is better to have a slight haze of smoke from the chimney than a white fire.

Efficient oil combustion requires about 200 cu. ft. of air per pound of oil consumed.

CAST IRON STEAM & HOT WATER BOILERS

Boiler Rating — 0 Lbs Steam	Boiler Rating — Equival. Hot Water	Lbs. Oil required per Hour — to evaporate following Lbs of Water per Lb. of Oil 12 Lbs.	13 Lbs.	14 Lbs.	15 Lbs.	16 Lbs.
300	500	6.25	5.77	5.36	5.00	4.69
400	650	8.33	7.70	7.14	6.67	6.25
500	820	10.42	9.62	8.93	8.33	7.81
600	1000	12.50	11.54	10.71	10.00	9.38
700	1150	14.58	13.46	12.50	11.67	10.94
800	1325	16.66	15.38	14.29	13.33	12.50
900	1500	18.75	17.31	16.07	15.00	14.06
1000	1650	20.83	19.23	17.86	16.67	15.63
1200	2000	25.00	23.08	21.43	20.00	18.75
1400	2325	29.16	26.92	25.00	23.33	21.88
1600	2650	33.33	30.77	28.57	26.67	25.00
1800	2950	37.50	34.62	32.14	30.00	28.13
2000	3290	41.67	38.46	35.71	33.33	31.25
2200	3600	45.83	42.31	39.29	36.67	34.38
2400	3950	50.00	46.15	42.86	40.00	37.50
2600	4280	54.17	50.00	46.43	43.33	40.63
2800	4620	58.33	53.85	50.00	46.67	43.75
3000	4800	62.50	57.69	53.57	50.00	46.88
3500	5600	72.92	67.31	62.50	58.33	54.69
4000	6400	83.33	76.92	71.43	66.67	62.50
4500	7200	93.75	86.54	80.36	75.00	70.31
5000	8000	104.17	96.15	89.29	83.33	78.13
5500	8800	114.58	105.77	98.21	91.67	85.94
6000	9600	125.00	115.38	107.14	100.00	93.75
6500	10700	135.41	125.00	116.07	108.33	101.56
7000	11530	145.83	134.62	125.00	116.67	109.38
7500	12340	156.25	144.23	133.93	125.00	117.19
8000	13150	166.67	153.85	142.86	133.33	125.00
8500	13970	177.08	163.46	151.79	141.67	132.81
9000	14790	187.50	173.08	160.71	150.00	140.63
9500	15600	197.92	182.69	169.64	158.33	148.44

Courtesy American Standard Oil Burner Company, Oakland, Calif.

Fuel Oil Required to Maintain Different Evaporation Rates

HOW TO FIGURE A FUEL-OIL INSTALLATION

In sections where the Fall and Spring temperatures are comparatively mild, only a portion of the total radiation is necessary. This must be taken into consideration when estimating as follows for the fuel-oil consumption:

Example: Take a building having 4000 sq. ft. of steam radiation. Each square foot of radiation will condense 14 lbs. of steam per hour, with surrounding air at 70° F. Then:

$$\frac{4000}{4} = 1000 \text{ lbs. steam per hour condensed.}$$

As shown previously, 1 lb. of steam requires 1000 B. T. U. to make it. Then 1000 lbs. steam × 1000 B. T. U. = 1,000,000 B. T. U. required.

We now take fuel-oil at 19,000 B. T. U. per pound and a combined efficiency of 75% = 19,000 × 75% = 14,250 B. T. U. available and

$$\frac{1{,}000{,}000}{14{,}250} = 70 \text{ lbs. oil necessary to burn.}$$

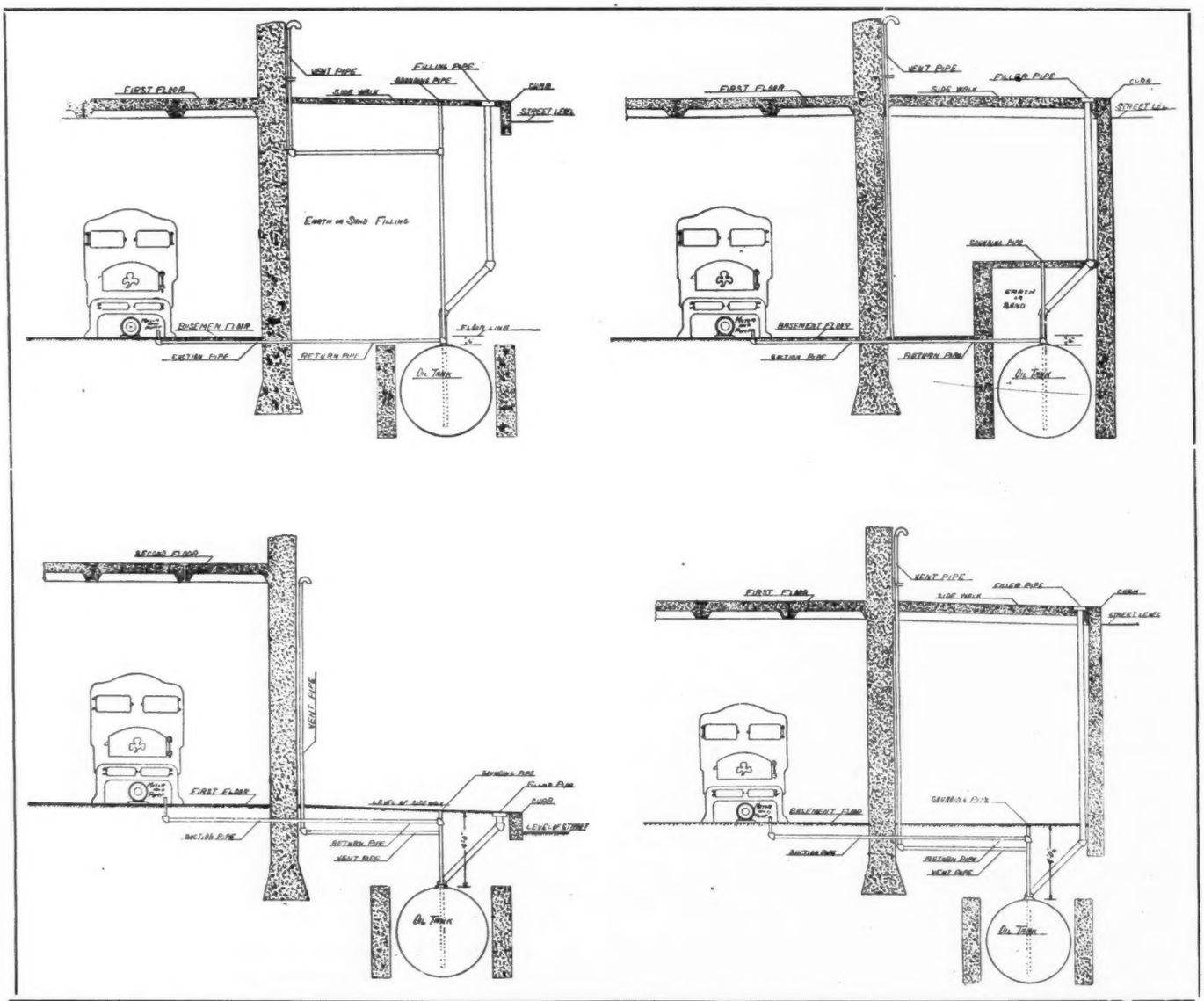
Estimating the fuel-oil at 7.8 lbs. per gallon = 8 gal. fuel-oil per hour necessary to maintain 4000 sq. ft. of steam radiation. Note the 4000 sq. ft. includes mains and risers in the piping system which is part of the load on the boiler.

The foregoing is for zero weather conditions. During mild weather about one-half of the capacity of the plant will be sufficient.

PRINCIPAL POINTS COVERED IN SPECIFICATIONS

A western specification for fuel-oil heating usually reads that oil burners of so and so's, or equal, manufacture shall be installed to fire each boiler, and goes on to give the size of the storage tank, details of combustion, etc., which, in any case, are governed by the local by-laws. In figuring or installing these jobs the following details govern:

The storage tank, unless otherwise specified, is standardized at 5 ft. diameter and 10 ft. in length. This holds a truckload of crude oil. In some towns these are of welded construction, costing $100.00. In other towns, riveted construction is insisted upon which brings the cost to $112.00.



Conventional Methods of Installing Oil Tanks and Connections

The sidewalk is excavated. Two rules govern this. There must be at least 4 ft. of earth above the oil tank and the tank must be 1 ft. below the boiler-room floor. In some districts, where sand is encountered, local authorities insist upon 6-in. concrete walls around the tank, but this is infrequent. It is usual to figure the cost of excavation and repair the sidewalk at anywhere from $50.00 to $110.00, according to local conditions, and assuming that rock will not be encountered.

Each tank is provided with a 12 in. x 16 in. manhole, and, on the better class of buildings, a manhole shaft of ¼ in. steel, with a suitable cover, is specified. To the tank is welded a 4 in. coupling for the filling pipe. It is usual to figure about 10 ft. of 4 in. standard black pipe, with five 4 in. threads and two 45° elbows, to carry this over to near the curb, with a cast-iron cover (costing about $2.00), for the purpose of filling with oil direct from the company's truck.

Next is a 2 in. coupling, with a 2 in. pipe carried to the sidewalk level and with cast-iron cover, known as the sounding pipe. Most specifications call for a graduated sounding rod to be used here. There is a T on this pipe from which a 2 in. vent is carried to the wall of the building. It is run up 15 ft. and capped with a U-bend. In wooden structures it is placed on the face of the wall, and in fire-proof structures, it may be encased in the concrete or brick, with a bend or elbows looking out toward the street.

SUCTION PIPE MUST BE ABSOLUTELY TIGHT

Next is a 3 in. coupling for the suction pipe. The suction pipe is 2 in. for small or medium installations, and 2½ in. for larger ones. This runs through the building in a trench to the boiler room. It must be absolutely free from any sign of leakage. It reaches to within a few inches of the bottom of the tank and a caulked lead joint is made at the 3 in. coupling. Should the tank settle, no fracture would occur by this method. It is customary to cap this pipe and test it to 20 in. of mercury vacuum for 24 hours, for the slightest leakage here would put the system out of commission. A 1¼ in., or larger, relief pipe extends from the boiler room back to the tank.

The majority of the heating contracting firms do just this much of the work and sublet what is known as the "boiler room end" to an oil-burning organization, but there are some firms which have experienced mechanics who save money by doing the "boiler room end" themselves.

THE TWO TYPES OF BURNERS IN COMMON USE

Burners are divided into two distinct types. One type is known as the "turbine" or "straight shot" burner which has a pump and blower mounted on a foundation in the boiler room. It is connected to the suction and relief pipes and, through piping under the floor, or in trenches, to the boiler or boilers. The other, which is known as the "rotary" type, has the motor and all apparatus connected directly to the front of the boiler. Opinions differ as to which type is preferable.

The leading oil-burner manufacturers have issued blue prints showing the arrangement of fire-brick, and fire-clay settings for standard cast-iron and steel boilers, and are always willing to issue a new print showing arrangement, number of bricks, and pounds of high-temperature cement required for any unusual installation encountered. They also take the responsibility of providing a steel plate for the boiler front, with the correct size of draft opening, and of equipping each burner with a lever to be attached by a chain to the ordinary damper

(Continued on Page 45)

FUEL OIL

Specific Gravity.	Beaume° at 60°F	Pounds Gal.	Pounds Bbl.	Pounds Drum
1.0000	10.	8.33	349.9	916.3
.9929	11	8.27	347.3	909.7
.9859	12	8.21	344.8	903.1
.9790	13	8.16	342.7	897.6
.9722	14	8.10	340.2	891.0
.9655	15	8.04	337.7	884.4
.9589	16	7.99	335.6	878.9
.9523	17	7.93	333.1	872.3
.9459	18	7.88	331.0	866.8
.9395	19	7.83	328.9	861.3
.9333	20	7.78	326.8	855.8
.9271	21	7.72	324.2	849.2
.9210	22	7.67	322.1	843.7
.9150	23	7.62	320.0	838.2
.9090	24	7.57	317.9	832.7
.9032	25	7.53	316.3	828.3
.8974	26	7.48	314.2	822.8
.8917	27	7.43	312.1	817.3
.8860	28	7.38	310.0	811.8
.8805	29	7.34	308.3	807.4
.8750	30	7.29	306.2	801.9
.8484	35	7.07	296.9	777.7
.8235	40	6.86	288.1	754.6

Above Table is based on Formula..... $\frac{140}{130 + B^{\circ}}$ = Specific Gravity.

To correct Beaume Reading if Oil is at other than standard Temperature..... For every 10°F above 60°F..... add 0.7°B.
For every 10°F below 60°F deduct 0.7°B.

Approximate Heating Value of any Crude Oil:
B.T.U. per Lb. Oil = $18650 + 40(B^{\circ} - 10)$

42 Gals = 1 Bbl. 110 Gals = 1 Drum

Courtesy American Standard Oil Burner Company, Oakland, Calif.

Characteristics of Fuel-Oil

Control of Heat Output from One-Pipe Radiators

Details of a Method for Fixing the Ratio of the Steam-Filled Space Within the Radiator to the Air-Filled Space

By S. Homer Woodbridge

ONE method of controlling the thermal output from radiators is more simple and effective than common or convenient, and more used abroad than in this country. In proportion to the covering in of a radiator, to the suppression of radiation and the reduction of convection, the rate of thermal output is reduced. The covering in may be accomplished by enclosing the radiator in any kind of casing which may be graduated as to opening, according to heat requirements.

The same effect may be produced by covering and uncovering radiators with a blanket, the degree of cover and uncover affecting the rate of heat yield. This crude method has the advantage of completeness and quickness in action and results. For a considerable period it was used for controlling the temperature of air supplied to the Legislative Halls of the English Houses of Parliament. When orders were received from the floor officials for a change of temperature, that change could be instantaneously made without waiting for the cooling or warming of masses of metal.

VARYING STEAM PRESSURE WITHIN RADIATORS

In common practice one-pipe radiators are for the most part either steam or air-filled. If steam-filled, the temperature of the radiator shell varies but slightly with the temperature of the contained steam. The range of steam pressure and temperature ordinarly usable in such radiators is small. If the pressure range be from 10 in. vacuum to 30 in. (mercury) plenum the corresponding temperature range of shell is from 195° F. to 218° F. If a given radiator so steam-filled is exposed to air and other surroundings having a fixed temperature of 65° F., the difference of temperature in the two cases between the radiator surface and surroundings becomes 135°, for the lower, and 153° for the higher pressure. The thermal output from the radiator varies as a certain function of that temperature difference, the rate of thermal output increasing with a slightly greater rapidity than the rate of rise of temperature difference. By this method, of varying the steam pressure, the range of thermal output within the range of pressure assumed is limited to approximately 20%, a range of low value, except when employed to make good a deficiency of 17% in the heating surface intended for use under low-tension steam pressure.

AIR BINDING

A method of controlling thermal output from a one-pipe radiator through any range desired is that of fixing the ratio of steam-filled space within the radiator to the air-filled space. The air-filled space is practically inert as to thermal value. Only the steam-filled sections of the radiator are thermally effective. If, then, steam be gradually admitted into one end of a one-pipe radiator, and air be allowed to escape as gradually through an air valve at the other end of the radiator until the desired number of sections are air-emptied and steam-filled, and if the air valve is then closed against the further escape of air, the thermal output from the radiator may be controlled through any range desired—and the rate of output may be held indefinitely as wanted.

This is a simple and effective manner of temperature control of rooms, provided radiators and air valves are tight. The method may be made automatic by connecting a pneumatically-operated air-venting valve by tubing with a reservoir of volatile liquid, the reservoir being of such type as to be held at will between those radiator sections at which it is desired to limit the escape of air and the filling with steam. The warming of the liquid produces a pressure through the tubing on the flexible diaphragm actuating the air valve, closing that valve and holding it fast closed so long as the surface of the steam-heated section with which the reservoir of volatile liquid is in contact remains hot enough to volatilize the pressure-producing liquid.

BALANCED PRESSURES

A further method of control of thermal output from one-pipe radiators, and with steam at any pressure usual in steam heating work, is that which is so simple and effective and generally applicable as to merit the attention of heating designers, and to be adopted in the practice of steam-fitting shops and offices.

Connect a radiator with one and the same properly-proportioned vertical pipe for steam supply and condensate return in the manner shown in the accompanying illustration. There is then ready at hand all the facilities and advantages to be had from a two-pipe radiator furnished with a modulating valve for supplying steam and a thermostatic trap for disposing of condensate without waste of steam.

The condensate fills the ¾ in. pipe which drains the radiator to a level above the sensitive and reliably-operating check valve, C, at which the pressure of the weight of the water column, and of air or steam above the column, overbalances by a little

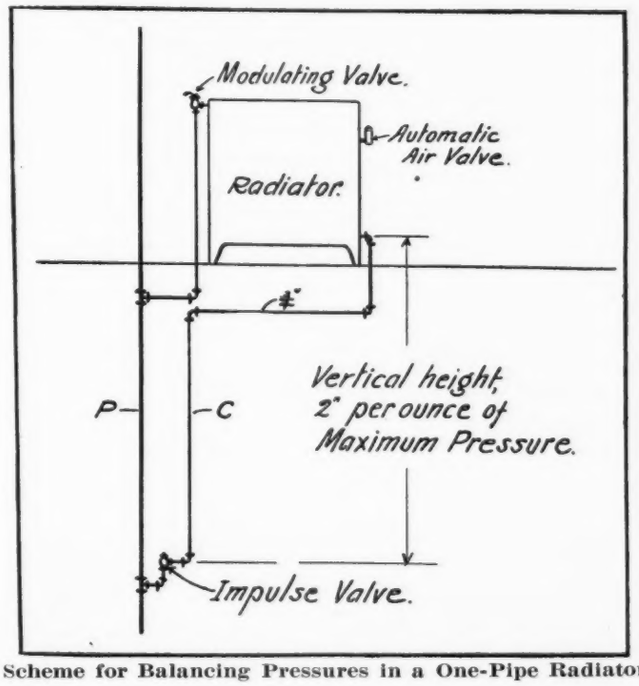
the pressure of the steam in the pipe, P. The check valve then opens allowing water to escape until the height of the water column in C, plus the air or steam pressure, produces a less pressure on the valve than that of the steam in P, a condition which tends to close the check valve.

The pattern of check valve best adapted to this service is believed to be the Jenkins' impulse check valve because of its form, which furnishes a balanced and vertically-hung valve, and which favors self clearing of debris material which, if lodged, would result in noisy steam leakage into the water in C, awaiting escape.

Placing the check valve at the level of the base of the radiator would result in filling the radiator with condensate except as the combined pressure of water column, and of air or steam, within the radiator exceeds that of steam in P, as also on that part of C. below the check valve, sufficiently to open the check.

Such an arrangement would be fatal to any usefulness of the modulating valve, and would result in such a retention of condensate in all the radiators of a system so valved as to alternately empty the boiler of water because of transfer of water to radiators, and then to flood the boiler when, under changed pressure conditions, that stored water returns to the boiler.

To radiators on so low a level with reference to



Scheme for Balancing Pressures in a One-Pipe Radiator

the boiler water-line that the check valve location, to function as proposed, must fall below that level, the method cannot be successfully applied. The method is applicable only to radiators sufficiently elevated above the water-line to bring the check valve at the foot of the pipe C, safely above that line. The lower the maximum steam pressure for which the system is intended, the shorter may be the vertical length of the pipe C, or 1.8 in. per ounce of maximum steam pressure to be carried.

For the escape of air from radiators, as also for the drainage of condensate from them without the aid of steam pressure within the radiators, it becomes important that all radiators of a system of the type here described be provided with reliable automatic air valves.

Under certain limited conditions of maximum steam pressure it is quite possible to successfully substitute for the water leg and impulse check valve a U siphon trap of length, or vertical height, sufficient to prevent the passing of steam through the water seal of the trap, from the steam main to the radiator. The uncertainty in the performance of such a device is solely that resulting from excesses in steam pressure allowed above the maximum intended, and made possible through carelessness in the matter of pressure control, or the inadequacy of provided automatic means for that purpose.

How They Heat With Fuel-Oil On The Pacific Coast

(Continued From Page 43)

regulator for the purpose of regulating the supply of oil, according to the pressure obtaining at the boiler.

From the foregoing it may gathered that an oil-burning installation is a very simple matter for the heating contractor associated with his work. The actual installation and adjustment of the burner requires the services of a mechanic experienced in all the eccentricities of this apparatus. The pipe work, firebrick work, etc., can be done in the ordinary course of the day's work by any steam fitter.

The sectional area of the chimney stack required is considerably less than that in common use for coal burning. The "horrible examples," sometimes cited in the East, of unsuccessful fuel-oil burner installations, showing the clogging of the furnace interiors and chimneys would cause nothing but surprise in California. Everybody there expects that an oil-burning equipment, once installed at a cost, say, of $900.00 complete for small installations, and more, in proportion, for larger buildings, will, after adjustment, function with a minimum of attendance and no "come-backs" for an indefinite period.

Another item which may be mentioned is the fuel-oil gauge. This is a graduated glass U-tube containing a red liquid, which is connected to the tank by a small brass tube, and is installed in the boiler room. It shows the amount of oil in the tank at any time.

In California no preheating of the oil is necessary, but in cold districts it is customary to have a corkscrew-shaped steam coil installed around the suction pipe in the tank to insure the correct viscosity. A preheater may also be placed on the suction line just before it reaches the pump.

Welded Piping In Buildings

By H. E. Wetzell

The Smith & Oby Co., Cleveland, O.

THE applied science of pipe welding is comparatively old. But its field has recently been extended to the welding of piping systems in buildings. Almost simultaneously from different sections of the country have come reports of building piping installations made with the aid of the oxy-acetylene blowpipe. These indicate that rapid strides are being made with this development which is so vitally interesting to piping contractors because it affects their work, procedure and processes.

The oxy-acetylene process has been used for some years as an important and accepted means of fabricating piping in the shops of individual companies and pipe lines in the field. That it has proved successful and economical in these applications predicates its advantages to the building industry. The men who specify welding for pipe lines and plant piping are usually the owners themselves, who, being free to choose their own methods, select the welded pipe joint because of strength, durability, tightness and economy. But the men who propose welding of building piping are subject to the desires or specifications of the owner, architect or engineer of the building.

To this condition can probably be attributed the fact that the practice of welding building piping is only at this time getting into full swing. The authorities mentioned had to be convinced and they have been convinced. The passive interest heretofore shown by these authorities in the welded pipe joint was probably largely due to lack of complete information on the subject. One engineer, for instance, thought a branch was welded to a main line by cutting a hole in the main line large enough to permit entrance of the branch which was then welded in without knowing its amount of projection into and consequent obstruction of the main line. On the contrary, however, the branch is not inserted into the main line. The procedure in making a branch connection is to shape out the end of the branch pipe with a cutting blowpipe so that it will fit the contour of the main pipe. Then the branch is butted up to the main and the latter marked by chalking around the circumference of the branch. Next, a hole is cut in the main line inside of the chalked circle but equal in diameter to the inside of the branch. Finally, both the hole in the main line and the end of the branch are beveled, fitted and welded, giving the equivalent, so far as internal pipe friction goes, of a cast fitting.

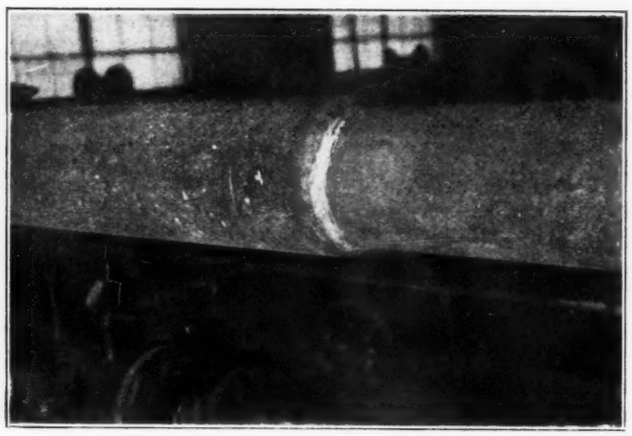
STRENGTH OF WELDED JOINTS

The welded joint is stronger than any of the types of threaded joint. This is manifest when one considers that in threading a pipe its wall is appreciably cut into, thus reducing its transverse strength, in some cases as low as 50%. In the case of the welded joint, however, especially where the weld is built up, the strength at least equals, and in most cases exceeds, the strength of the pipe wall itself.

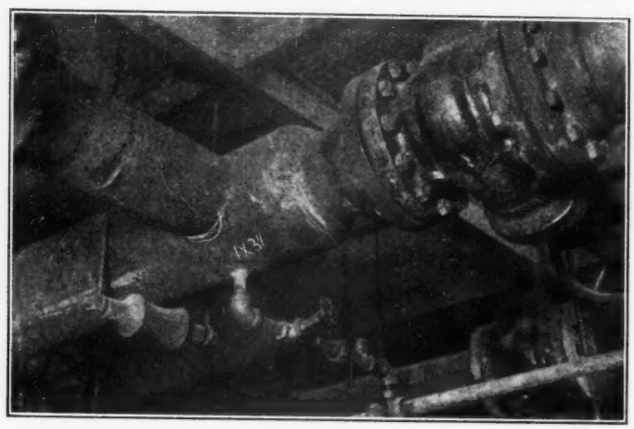
Installation time and expense are saved when piping is welded. Consider the advantage of taking standard lengths of pipe to the job, then merely putting them in position, cutting and fitting them with the cutting blowpipe, then welding adjacent lengths together with the welding blowpipe. All thread cutting, leading, packing and caulking is avoided. Also, the use of the welding process obviates the necessity of a very detailed piping layout and the necessity of using a specifically marked length for a certain location.

The direction of run of the pipe line can be altered at will. It is merely necessary to cut butting ends to the desired angle with the cutting blowpipe, then weld them together. Special fittings are unnecessary.

In fact, no fittings are necessary other than valves and those which can be readily fabricated on the



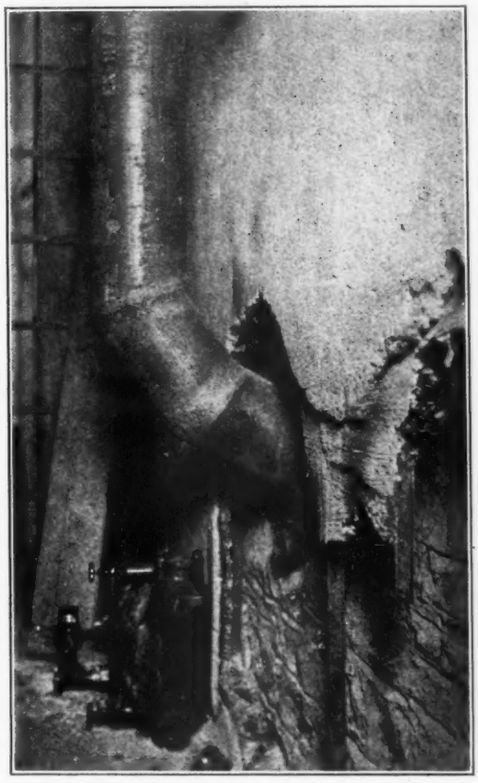
Example of Welded Reducer



"T" Connection Welded in Place to Large Main

job from the pipe itself. This fact also has a material effect on the cost in that the expense of the cast fittings are avoided. Furthermore, since the use of fittings is avoided the weight and hence the handling time and cost of the piping is materially decreased, especially in power installations.

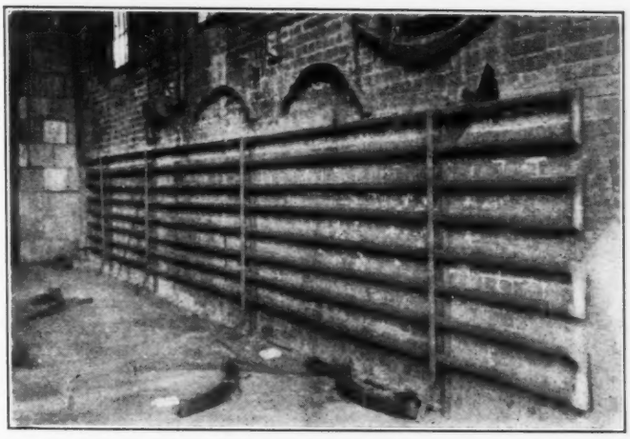
The corrosion which usually takes place at threaded joints and the leakage at gaskets and threads of flange connections, is avoided when pipe joints are welded. The weld, when built up, makes the joint the thickest part of the pipe line and, therefore, the part which offers most resistance to corrosion. Hence, the life of an all welded pipe line may be said to be determined only by the life of the pipe itself.



Welded Pipe Bend Which Eliminated Fittings

Alteration of piping can be readily handled by means of the welding process. For example, take the simple case of adding a branch to a main line. The work required consists merely in cutting a hole in the main line with the cutting blowpipe, then welding the branch to the main line. Contrast this with the work required should the job be handled with screwed connections, while length of pipe would have to be removed, cut, and threaded, the branch connection threaded and the three resultant ends joined by a cast "T" connection. In other words, two joints to break, two cuts to make, three threads to cut and, finally, five joints to make.

Another good feature of welded piping systems is their appearance. They present a smooth continuity of line unbroken by joints or fittings. And



Heating Coils All Welded

when it is necessary to cover such a line, the insulating jackets can be kept uniform. Large flange covers are obviated.

The advantages of welding building piping are summed up in the following statements. Strength is increased. Close work and numerous branch connections are easily handled. The cost of thread cutting and fitting is done away with. The added weight of fittings is avoided, thus reducing handling costs. Corrosion which usually takes place at threaded joints is insured against, as is also leakage at threads and gaskets. The use of welded piping in buildings is thus both economical and practical.

A Welding Job Which Solved an Interesting Pipe Line Problem

The Rise of Steam Flow Meters in Central Station Heating Service

How the Practice Has Developed of Selling Steam at the Source of Supply, Due to the Additional Demand for Free Steam for Cooking and General Industrial Use

By Henry Allen

Some idea of the timeliness of the accompanying article may be gained from the statement that a number of the largest central station heating companies are at present contemplating the installation of many steam flow meters. The reasons for this trend are explained at length in the article, together with the salient points of the principal types of meters.

THE EARLY steam heating systems were all low-pressure systems. However, as the business expanded, customers demanded high-pressure steam for operating elevators, pumps, cooking, heating water, operating printing presses, and for other uses. To-day the high-pressure systems of New York, Boston, Pittsburgh, Detroit, Chicago and St. Louis are the largest heating systems in the world. Steam is furnished from boilers whose pressure is as much as 300 lbs., delivered to mains at 185 lbs. pressure, and to customers at a pressure from 150 lbs. to 1 lb., as desired by the customer.

The largest boiler in the world, a 3000-H. P. boiler, was recently installed by the Allegheny County Steam Heating Company, in Pittsburgh, Pa. This company is spending $2,000,000 on one of its steam heating stations. Grand Rapids has just expended $1,000,000 on its steam heating power house and steam distribution systems. Boston, Rochester, New York, Detroit, St. Louis, Grand Rapids, Pittsburgh, Seattle, Spokane, Portland and other cities have spent $15,000,000 on steam heating withing the past five years. From all appearances more money will be spent in the immediate future.

THE TWO IMPORTANT FACTORS IN CENTRAL HEATING SERVICE

The two things that have made steam heating profitable to the utility company and popular with the customers are:

(1) Accurate measured service coupled with equitable and adequate rates.

(2) Economical regulation of steam requirements.

The steam heating companies have all successfully used condensation meters for the past twenty years. Inasmuch as they are familiar to the heating companies, their discussion will be omitted in the present article and the writer will pass on to the discussion of flow meters.

DEVELOPMENT OF STEAM-FLOW METERS

Steam-flow meters were used to measure the station output by steam heating companies for a number of years before they were adopted for measuring the individual customer's consumption and thereby permitting an accurate determination of the value of steam used based on the meter readings.

Some customers called for a class of service on which a condensation meter could not be used such as free steam for cooking, steam for engines, elevator pumps and general industrial use. Personally, the writer, after sixteen years operation of central heating plants, is a firm believer in the sale of steam at the source of supply. A flow meter placed at the point where the service enters the customer's premises, measures all steam that enters the building, while a condensation meter measures what passes through flow meter, less leaks and other "unaccounted for" losses. This constitutes a loss of 10% to 30%, depending on the kind of heating steam served.

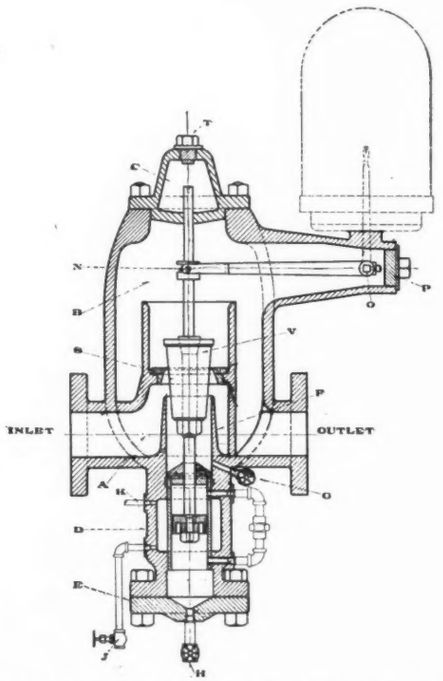


Fig. 1.—Construction of the St. John Flow Meter

Following is a discussion of several types of flow meters that are used for this purpose.

THE ST. JOHN FLOW METER

The St. John flow meter is the oldest and most popular flow meter for measuring the sale of steam by steam heating companies. It is used exclusively by the New York, Chicago and St. Louis companies and, in conjunction with other meters, by utilities

of Boston, Detroit, Rochester, Cleveland, Pittsburgh, Milwaukee and other cities.

The St. John flow meter is adapted for pressures varying from 10 lbs. to 300 lbs. and indicates and records the quantity of steam flowing through the pipe line in which the meter is placed. The steam enters the inlet, raises the valve "V," passes into chamber "B," and finally leaves by way of the outlet. The lift of valve "V," which is a measure of the steam flowing, is transmitted by levers to the pencil point, which, in turn, traces a consumption line on the ribbon chart, which chart is driven by clockwork. Each meter is tested and calibrated under actual operating conditions before shipment by the manufacturer.

G. E. MECHANICALLY-OPERATED FLOW METER

The sectional view of the G. E. indicating, recording, and registering flow meter, is rather complex, and the principle of operation can better be understood by picturing a U-tube of mercury, on one side of which there rests a float.

As the differential pressure varies, the mercury in the U-tube will rise and fall. The internal mechanism is so designed that when the float rises from zero to its extreme uppermost position, the internal magnet connected to it will rotate through 280°. The motion of this magnet is transmitted through a copper plate to another magnet; and it is to the shaft of this outer magnet that the indicating, recording and registering devices are connected.

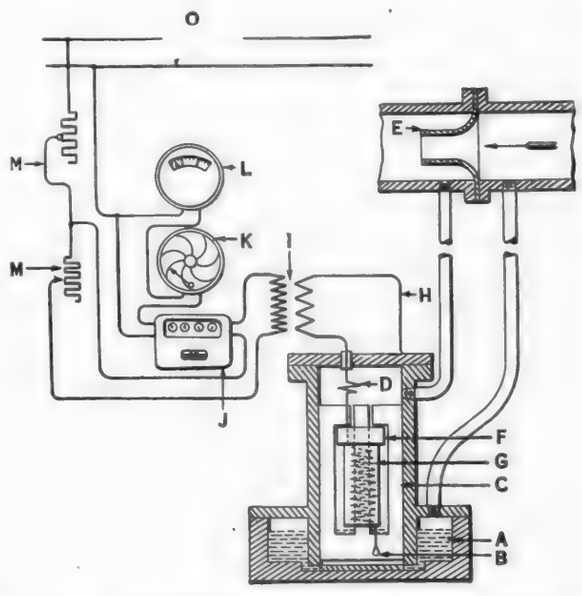


Fig. 2 — Diagrammatic View of G-E Electrically-Operated Flow Meter

A = Mercury
B = Ground connection of primary coil
C = Transformer laminations
D = Flexible rubber covered lead to primary coil
E = Flow nozzle producing a differential pressure
F = Insulating compound covering primary coil
G = Primary coil
H = Ground connection of transformer
I = Transformer mounted on meter body 108/5 volts
J = Watthour meter
K = Curve drawing ammeter
L = Indicating ammeter
M = Adjustable resistance compensating for line drop
N = Voltage regulator resistance in series with line
O = Alternating-current supply

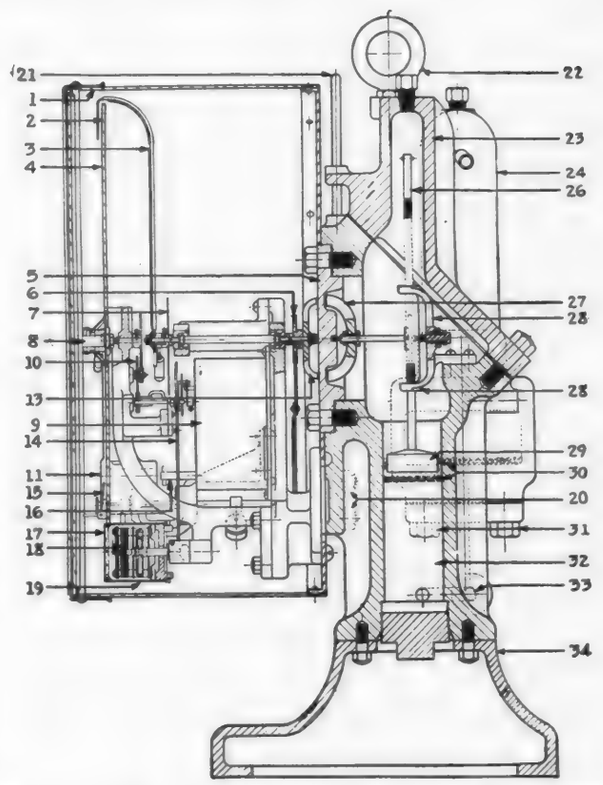


Fig. 3 — Sectional View G-E Indicating, Recording, Registering Flow Meter

1 Case containing external mechanism
2 Indicating scale plate
3 Indicating pointer
4 Recording chart
5 Copper plug
6 Pinion
7 Register cam
8 Chart lock nut
9 Clock driving chart and register
10 Gears driving chart
11 Recording pen arm
13 External mechanism magnet
14 Arm driving register
15 Recording pen lifter
16 Spring motor winding stem
17 Register front glass
18 Register gears
19 Register case
20 Stud bolts holding external mechanism
21 Cover plate guide rods
22 Eye bolt
23 Dome for rack
24 Removable mercury chamber
26 Internal mechanism rack
27 Internal mechanism magnet
28 Guides for rack
29 Internal mechanism float
30 Mercury
31 Cap screws holding removable mercury chamber
32 Float chamber
33 Passage connecting float chamber to removable mercury chamber
34 Sub-base

G. E. ELECTRICALLY-OPERATED FLOW METER

In the G. E. electrically-operated flow meter the difference of pressure is brought down from the flow nozzle to the inner and outer legs of a U-tube of mercury. The internal element or primary coil is placed in this inner leg and, as the flow and hence differential pressure increases, mercury will be forced up around the primary coil. The two together form a transformer, of which the mercury ring forms a closed secondary, inducing as it rises more and more current, and therefore causing an increasing amount of current to be drawn through the primary coil.

The electrical circuit through the meter body can easily be traced from the accompanying diagram. From the meter body the current at 5 volts is steped up to 108 volts and runs through the indicating, re-

cording and totalizing instruments. These instruments, instead of reading amperes and watts, respectively, are calibrated to read the flow direct in pounds of steam per hour; and since the regulator, N, holds the voltage constant, the amount of current drawn will vary directly as the height of the mercury surrounding the internal element, which,

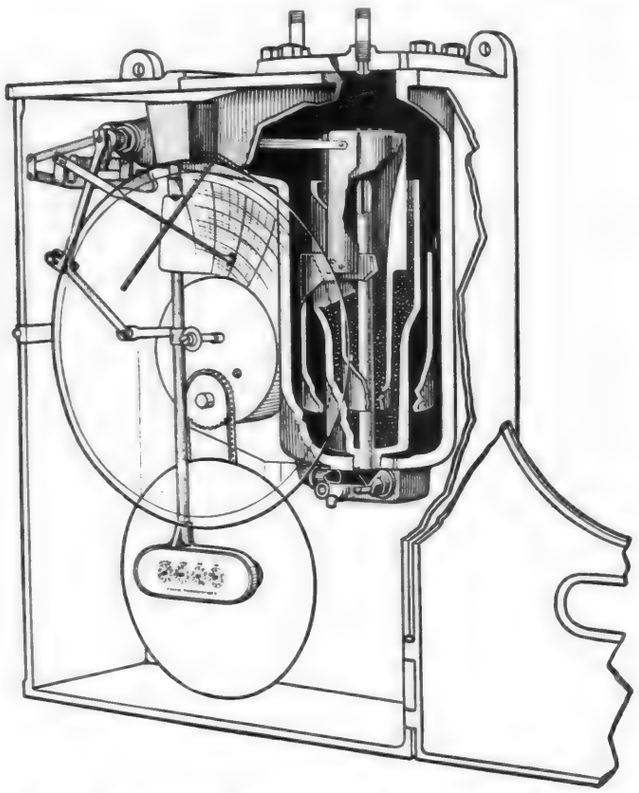


Fig. 4—Design of the Bailey Steam-Flow Meter

in turn, varies as the differential pressure and, hence, the flow in the line.

BAILEY STEAM-FLOW METER

The Bailey meter steam-flow mechanism, shown in cross section, is operated by the pressure difference across a thin-plate orifice inserted in the steam line. The differential pressure transmitted to the meter by connecting piping is applied to a mercury sealed Ledoux bell, which is so shaped that its motion is directly proportional to the rate of steam flow. The motion of the bell is transmitted to a pen, recording on a uniformly-graduated chart and likewise to an integrator, which moves over a clock-driven disc and gives the total steam flow on a four-dial counter.

THE COCHRANE INTEGRATING FLOW METER

In the Cochrane flow meter the deflecting and actuating member is a U-tube containing mercury and balanced upon a knife edge. Pressure from the two sides of a metering element, such as an orifice or nozzle in a steam line, are led to the two limbs of the U-tube through small, flexible torsion tubes, placed close to the axis of rotation of the balance. The pressure differential set up by flow through the pipe line forces mercury from one side to the other of the U-tube, causing the latter to tilt. In order that the tilting may be proportional to the rate of flow, the U-tube carries a cam which presses against a metallic ribbon kept taut by a weight.

The integrator used with this flow meter is driven solely by the clock, the deflecting member of the meter only controlling the position of a stop or motion-limiting pin. Referring to the accompanying illustration, the crank A is fastened to a spindle of the clock. As it rotates, it strikes against the springs I and H and causes the lever B to rock about a pivot.

The lower end of lever B is slotted and engages the pin D of the oscillating yoke C, which is pivoted at K. The yoke C straddles the clutch disc N, which is geared to the counting train. When C moves in a counter-clockwise direction, its motion is transmitted to the clutch disc N by means of the friction clutch M. When yoke C moves in a clockwise direction, the clutch M automatically releases its grip on the clutch disc N and does not transmit the motion of the yoke. The clutch disc N is prevented from moving in a clockwise direction by a spring brake applied to the spidle of the disc.

This device thus records an amount upon a counting train, or registers, once a minute. To make it register a quantity proportional to the total flow over a definite period, it is only necessary that the amount registered each minute be proportional to the momentary rate of flow.

THE REPUBLIC FLOW METER

In the Republic flow meter the ammeter and wattmeter are applied directly for measuring the flow of fluids in pipes. The electric current used is regulated by the differential pressure of the flow and in that way registers the amount of flow. A

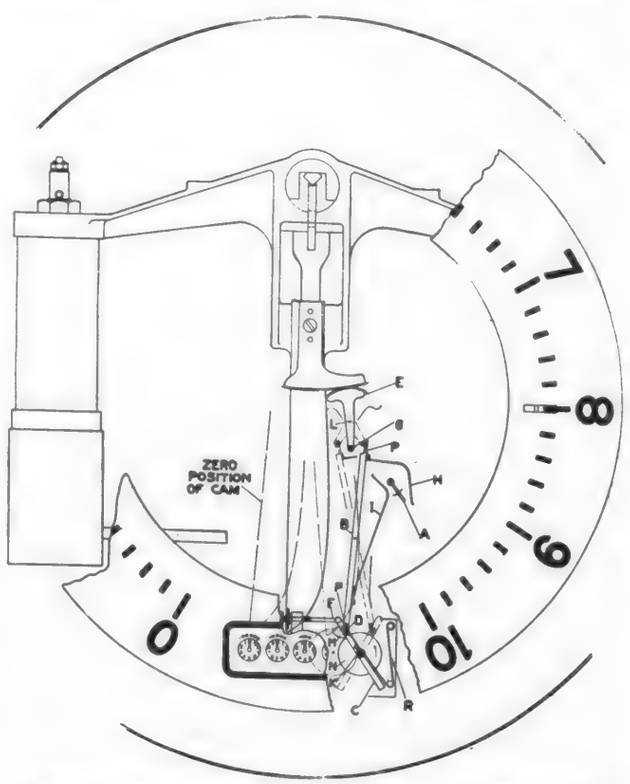


Fig. 5—Integrator Drive of Cochrane Integrating Flow Meter

Pitot tube or orifice disc is used to obtain the differential pressure of the flow.

By referring to the accompanying illustration, it will be noted that the two pipes terminating with globe valves are connected to the differential medium by 3/8-in. piping. When there is a flow in the line, the dynamic pressure, admitted to the left-hand connection, becomes higher than the static, admitted to the right-hand connection. The dynamic connection leads to the mercury well and the static connection to the annular space around the contact chamber. The rise and fall of the mercury in the contact chamber, which varies in proportion to the impact of flow, adds or cuts out a given part of the resistances to which the overhanging rods are connected, thereby regulating the amount of current flowing through the electric circuit. The resistances are so divided by the contact rods that the flow of current in the circuit is directly proportional to the flow of fluid in the pipe. The electrical instruments, while measuring the current regulated by the flow, actually register the amount of fluid passing through the pipe.

HOW USE OF STEAM FLOW METERS HAS EXTENDED

Steam-flow meters have become so popular with both the customer and the utility company that they

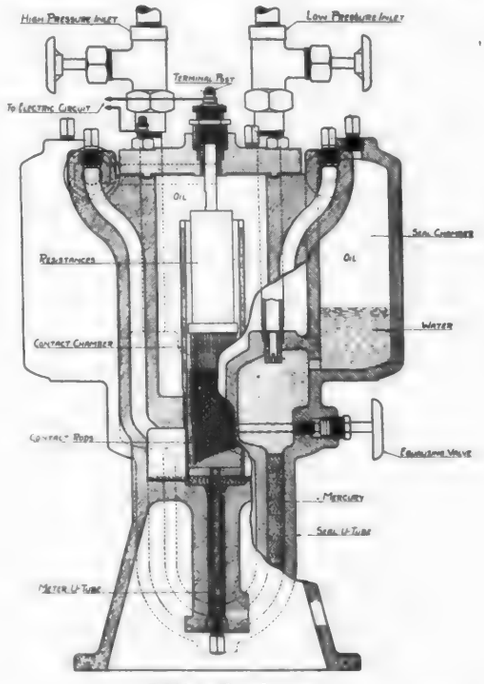


Fig. 6—Construction of the Republic Flow Meter

have come into common use by all heating companies. They are also used in power houses, on steam mains and so generally that some heating companies use hundreds of flow meters. Flow meters have made it possible to measure the steam that is made in the boilers, that is sent out from the power house and that is purchased by the customers. Every pound of steam that leaves the boilers can be accounted for.

Heating companies are training experts to test their flow meters and to calibrate them, all of which requires a laboratory equipped so that there are

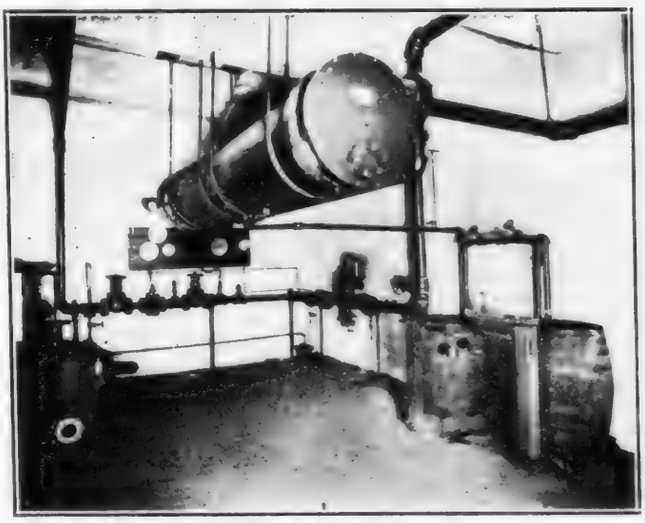


Fig. 7—Testing Apparatus for Testing Accuracy of Steam Flow Meters

pyrometers, thermometers, gauges, superheat recorders, calorimeters, reducing valves, scales, condensers, water and steam mains and boiler supply sufficient for testing up to 1,000 H. P. capacity.

NEED OF METER TESTING PLANT

There are two reasons for such a meter testing plant, namely,

(1) To test company's operating meters.
(2) To test customer's individual meter.

Such testing must be done when a customer complains of an abnormal bill, but all meters should be tested periodically, as many as possible during the summer months, in order to detect any tendency toward inaccuracy and thereby forestall complaints.

METER TESTING

What is the result of an unusually high steam bill? If the customer is not sure that he has used the amount of steam indicated, because of increased business or some abnormal cause, he will say that the meter was mis-read or that it is fast. If the meter has been mis-read, the matter can be solved very easily by having another reading made. However, if the customer insists that the meter is wrong, it is necessary to remove the meter and take it to the shop for a test.

The method of testing depends entirely upon the type of meter to be tested. There are two general types of meters used in the measurement of steam for heating buildings, one being a condensate meter and the other a flow meter. The testing of condensate meters is a very simple process, as the meter measures water, the meter can be tested by running water through it and weighing the discharge. With the high-pressure flow meter we have a different problem, because the discharge from the meter is steam which must be condensed before any check can be obtained.

The apparatus necessary for testing flow meters must be of such a nature as to be able to maintain the normal working conditions of the meter throughout the test. To do so, the pressure must be regulated to meet the operating pressure of the meter and the quantity of steam flowing must be controlled

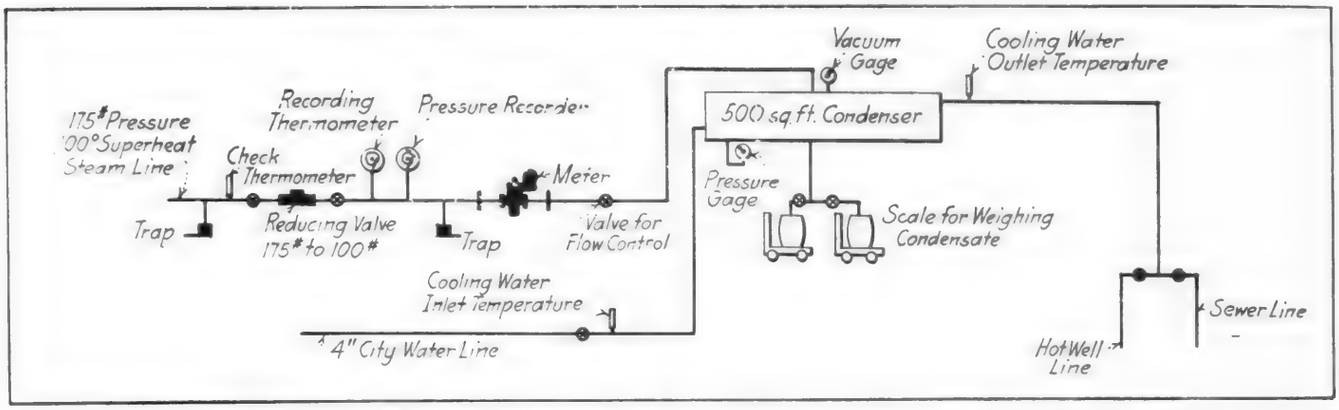


Fig. 8—Arrangement of Apparatus for Testing Accuracy of Steam Flow Meters

so that the meter can be checked at different loads.

ARRANGEMENT OF TESTING APPARATUS

The testing apparatus that we use in checking the accuracy of St. John's flow meters (shown in Fig. 7) consists of two traps, four indicating thermometers, one recording thermometer, one recording pressure gauge, reducing valve, meter flanges, one 500 sq. ft. condenser and scales for weighing condensate. The arrangement of the apparatus is shown in Fig. 8.

The cooling water is taken from the city water supply line of the plant after it passes through the condenser, it is discharged into the hot well or sewer, depending upon conditions in the plant at that time. The steam, after being condensed and weighed, is also discharged into the hot well. By discharging all of the water into the boiler feedwater system of the plant, the actual cost of the test involves two items of expense, namely, the value of the man's time chargeable to the test and a portion of the cost of the steam consumed.

After the meter is placed in position for the test and the steam turned on with the flow valve closed, the zero position of the pencil mechanism can be checked. By varying the opening of the valve between the meter and the condenser, the rate of steam flow can be controlled. The condensate is first turned into one of the two barrels mounted upon the platform scales and then into the other. After the weight of the condensate is recorded, the barrel is drained and made ready for refilling.

By making tests at different pressures and various loads, the accuracy is determined for each of the test conditions. The dependability of the meter is not as important ordinarily as is the average reliability under all of the conditions.

The amount of steam as recorded by the meter is obtained by multiplying the meter constant, as furnished by the manufacturer, by the mean ordinate of the chart. The mean ordinate of the chart is found by the use of a planimeter.

If it is desirable to know the effect of the meter upon the temperature and pressure of the steam, it would be necessary to have a gauge and a thermometer placed between the meter and the valve which controls the flow. With the aid of these instruments we would be enabled to determine the effect of throttling upon the temperature and pressure of the steam.

If the results of a test show that a meter is consistently high or low, the correction can be applied in either of two ways, one being to apply a correction factor to the steam flow as shown by the chart and the other being to change the constant of the meter.

This testing plant was designed for testing the St. John's meters on our steam distribution system, but can and has been used in testing other types of flow meters.

In a subsequent article Mr. Allen will take up the second factor which has made central heating practical, as well as popular with the customer, namely, economical regulation of steam requirements.

Recovery of Contract Price Not Dependent on Literal Compliance

In an action for a balance due on a special contract under which the plaintiffs had put into the defendant's building a heating apparatus, the Illinois Appellate Court, Shepard v. Mills (1898) 173 Ill. App. 223, 228, said: "There were many details of minor importance to be complied with by appellees (the contractors) to carry out the contract, but it could not, in reason, be contended that no recovery could be had unless there was a literal compliance with the contract in respect to them. The rule is correctly laid down in Keeler v. Heer, 157 Ill. 57, that a literal compliance with such contracts is not necessary to a recovery, but it will be sufficient that there has been an honest and faithful performance of the contract in all its material and substantial particulars, and no omission in essential points or willful departure from the contract; and mere technical or unimportant omissions will not defeat a recovery of the contract price, less any damages, however, requisite to indemnify the owner."

In Krumholz v. Tobias (1912) 167 Ill. App. 533, where the court found that the contractor for the installation of a steam heating plant had complied with the terms of the contract in all material and substantial particulars, it held that he was entitled to recover the contract price less the expense of installing certain radiation.

A Short, Practical Method of Designing Gravity Water Heating Systems

With Six Illustrative Problems Frequently Encountered in Practice, and Their Solutions

By F. E. Giesecke

Professor of Architectural Engineering, University of Texas

V—Design of Two-Pipe Systems With Direct or Reversed Returns

Previous articles in this series are as follows: January, 1924, Design of an Elementary Heating System; February, 1924, Design of a Simple Water Heating System; April, 1924, Design of One-Pipe System for a Small Building; June, 1924, Design of a Simple Two-Pipe System.

LET it be required to design the pipe lines for the elementary two-pipe system as shown in Fig. 12, with direct return, and as shown in Fig. 13 with reversed return. The system shown represents a small portion of a larger installation.

Radiator I is to dissipate 10,000 B. T. U.; Radiator II, 8,000 B. T. U.; and Radiator III, 12,000 B. T. U. per hour. The radiators are located, with reference to the heater, so that the centers of the radiators are 7 ft. above the center of the heater. The water is to leave the heater at a temperature of 200° F. and to return at a temperature of 180° F. The heat dissipated by the pipe lines is to be neglected in determining the sizes of the pipe lines and radiators.

The water circulating through the system may take any one of three paths. The three paths lead respectively, through the three radiators, and the correct solution of the problem requires that the three paths be so proportioned that the water will distribute itself among the three paths so that each radiator will receive its proper quantity of heat.

DIFFERENCE IN PIPING WITH DIRECT AND REVERSED RETURNS

Before beginning with the design of the system it will be well to observe the difference between the method of piping with a direct return, as shown in Fig. 12, and that with a reversed return, as shown in Fig. 13. In the former system, the three paths, leading, respectively, through the three radiators, are of different lengths; the path leading through Radiator I is the shortest and that leading through Radiator III is the longest. In the latter system, the three paths, leading, respectively, through the three radiators, are practically of equal length.

It should be observed also that the system with direct return, shown in Fig. 12, requires less pipe than that with the reversed return, shown in Fig. 13. This difference in the length of pipe required for the two systems of piping occurs, however, only when the radiators are located along a line so that each radiator is farther from the heater than the next preceding radiator. When the radiators are arranged along a line which doubles back upon itself and returns to the heater, as is very frequently the case in practice, (see, for example, Fig. 7, THE HEATING AND VENTILATING MAGAZINE for April, 1924) there is very little difference between the lengths of pipe required for the two systems of piping.

THE FIRST STEP IN DESIGNING THE PIPING

To design the pipe lines for either system we proceed as explained for System III A (see THE HEATING AND VENTILATING MAGAZINE for June, 1924)

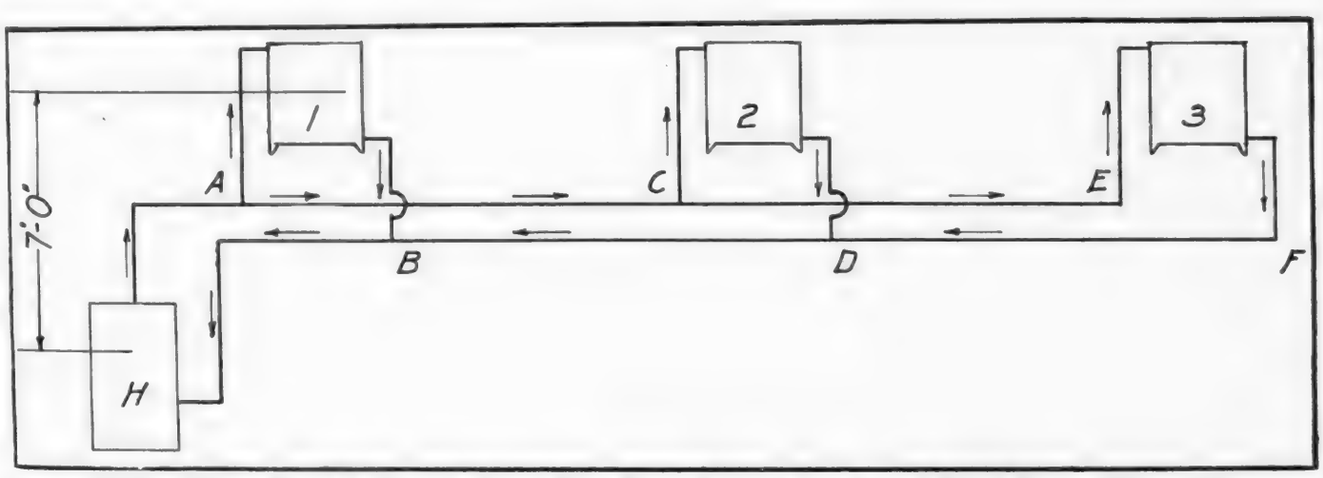


Fig. 12—Design of Two-Pipe Water Heating System with Direct Return

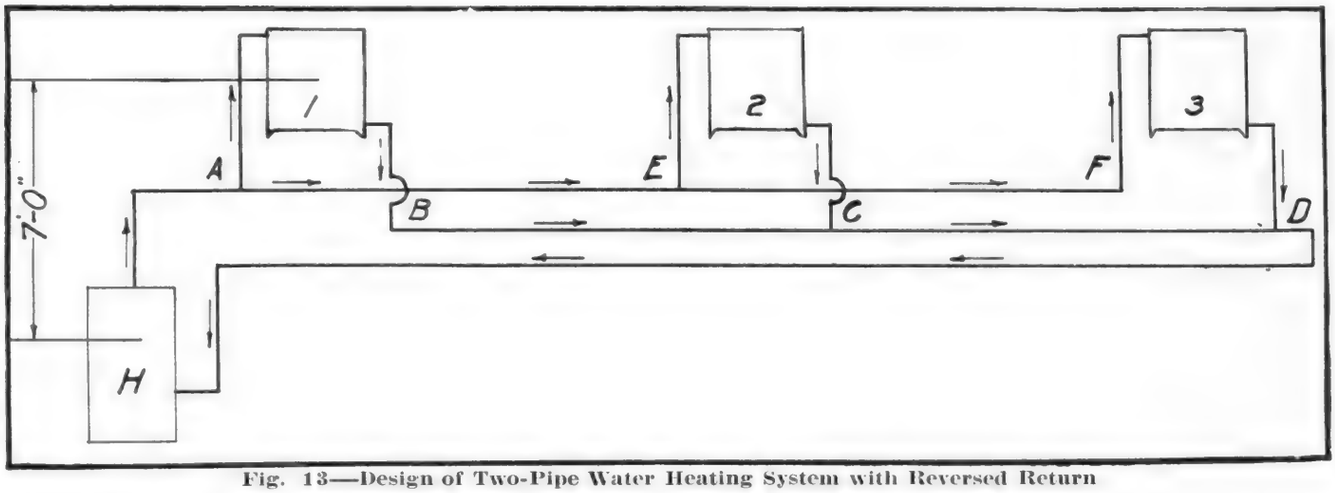


Fig. 13—Design of Two-Pipe Water Heating System with Reversed Return

i.e., we begin with the design of the circuit of the least-favored radiator. The least-favored radiator is generally the one which has the longest circuit for a given pressure head, or, in other words, the one which has the smallest available pressure-head per foot of the equivalent length of its circuit.

In the direct return system, Fig. 12, Radiator III is evidently the least favored of the three radiators. In the reversed return system (Fig. 13) all three radiators are practically equally favored since all have the same pressure head and all have practically the same length of circuit.

Let us begin with the design of the direct return system, Fig. 12, and design the circuit for Radiator III. We divide this circuit into eight sections, as indicated in the figure, and tabulate the data relating to the eight sections as shown below. To prepare this tabulation, the required data are found as follows:

The number of B. T. U. flowing through the several sections are found by inspection of the figure; the number of feet of pipe and the number of elbows in any section are found from a detail drawing (which should be available) or from an intimate knowledge of the proposed construction of the system.

The assumed diameter is found thus:

Add the number of feet of pipe in all sections included in the circuit; also add the number of elbows in all sections. Assume that the friction in one elbow is (very approximately only) equal to the friction in 2 ft. of pipe, and multiply the number of elbows by 2 and add the product to the number of feet of pipe to find the approximate equivalent length of the circuit. Divide this length into the total available pressure head for the radiator to find the approximate pressure head per foot of pipe for the circuit.

Thus, for Circuit III, there are 77.37 ft. of pipe and 21 elbows; the equivalent pipe length is, approximately, 77+(2×21) or 119 ft. and the average available pressure head is, approximately, 630÷119, or 5.3 m.i. per foot of pipe.

Refer to Diagram II (see THE HEATING AND VENTILATING MAGAZINE for January, 1924) and note that for 30,000 B. T. U. (Section H A) and a friction head of 5.3 m.i. per foot of pipe a 2 in. pipe is slightly too large; for 20,000 B. T. U. (Section A C) a 1½ in. pipe is slightly too small, and for 12,000 B. T. U. (Section C E) a 1¼ in. pipe is almost exactly right. These three sizes are, accordingly, selected as the assumed diameters. Experienced designers may select the assumed diameters without this preliminary calculation, but in most cases time can be saved by such approximate determinations.

The unit friction is found from Diagram II; the total friction is calculated by multiplying the unit friction by the corresponding number of feet of pipe and by the corresponding number of elbows.

CIRCUIT III

Pressure-head=7×90=630 m.i.

Section	B. T. U.	Elbows	Assumed Diameter, Inches	Unit Friction	Total Friction
		8		3.5	28
HA	30,000	4.5	2	12.0	54
		12		5.7	68
AC	20,000	0	1½		
		12		4.8	58
CE	12,000	0	1¼		
		5.7		4.8	27
E3	12,000	5.5	1¼	10.9	60
		2.67		4.8	13
3F	12,000	6.5	1¼	10.9	71
		12		4.8	58
FD	12,000	0	1¼		
		12		5.7	68
DB	20,000	0	1½		
		13		3.5	46
BH	30,000	4.5	2	12.0	54
Total					605

In the above calculation it happened that the assumed pipe diameters were so near the correct diameters that the total friction head (605 m.i.) differs from the available pressure head (630 m.i.) by only 4%. This agreement is sufficiently close for all practical purposes and we will select the assumed diameters for the installation.

DESIGN OF CIRCUIT II

We may now proceed with the design of Circuit II. This circuit is composed of six sections. Of these six sections, four sections form also a portion of Circuit III and have been determined by the design of Circuit III. There remain, therefore, only two sections to be designed, namely, C2 and 2D. The method employed for this design is practically

like the one explained for Circuit III. The results are shown in the following tabulation:

CIRCUIT II

Pressure-head=7×90= 630 m.i.

Friction-head in Sections H-A= 82
A-C= 68
D-B= 68
B-H=100 318

Available pressure-head 312 m.i.

Section	B. T. U.	Elbows	Assumed Diameter, Inches	Unit Friction	Total Friction
		5.7		8.4	47
C2	8,000	6.5	1	15.5	101
		2.67		8.4	22
2D	8,000	7.5	1	15.5	116
Total					286

In this case the total friction head is 286+312, or 598 m.i. This is 32 m.i. or 5.1% less than the available pressure head. This agreement is again sufficiently close to justify the selection of the 1 in. pipe for the installation. To convince ourselves that it is unnecessary to attempt to secure a closer agreement between the calculated friction head and the available pressure head, we find from Diagram II that the substitution of 2 ft. of ¾ in. pipe for 2 ft. of 1 in. pipe, or the substitution of one ¾ in. elbow for one 1 in. elbow in Section C2 would increase the friction in that section about 40 m.i.

Circuit I can be designed as explained for Circuit II.

CALCULATING THE REVERSED RETURN SYSTEM

We may now proceed with the reversed return system, Fig. 13. Since, in this system, all radiators are practically equally favored, we may begin with any one of the three circuits; Circuit I, for example. We divide the circuit into the six sections shown and, by assuming 2 in., 1½ in., and 1¼ in. pipe for the first trial calculation, we find, as shown in

CIRCUIT I

Pressure-head=7×90=630 m.i.

Section	B. T. U.	Elbows Feet	Assumed Inches Diameter,	Friction Unit	Friction Total
		8.0		3.5	28
HA	30,000	4.5	2	12.0	54
		5.7		3.3	19
A1	10,000	6.5	1¼	7.5	49
		2.67		3.3	9
1B	10,000	6.5	1¼	7.5	49
		12.0		3.3	40
BC	10,000	0	1¼		
		12.0		4.7	56
CD	18,000	0	1½		
		40.0		3.5	140
DH	30,000	6.5	2	12.0	78
Total					392

Section	B. T. U.	Feet Elbows	Selected Diameter, Inches	Unit Friction	Total Friction
		8.0			28
HA	30,000	4.5	2		54
		5.7		12.6	72
A1	10,000	6.5	1	24.3	158
		2.67			9
1B	10,000	6.5	1¼		49
		12.0			40
BC	10,000	0	1¼		
		12.0			56
CD	18,000	0	1½		
		40.0			140
DH	30,000	6.5	2		78
Total					554

the following tabulation, that the calculated friction head is 392 m.i., or 238 m.i. less than the available pressure-head. If we change Section A1 from 1¼ in. to 1 in. pipe, the total pressure head is increased to 554 m.i.; this is still 86 m.i. less than the available pressure head. If we reduce Section 1B also to 1 in., the friction head is increased to 688 m.i. and is 58 m.i. more than the available pressure head. We generally prefer to hold the calculated friction-head below the available pressure-head and for that reason we will select the pipe sizes shown in the table.

We may now proceed to Circuit II. This circuit consists of six sections of which three sections form also a part of Circuit I and were determined when that circuit was designed. We proceed as explained above and find the results shown in the following tabulation.

CIRCUIT II

Pressure-head = 7 × 90 = 630 m. i.

Friction-head in
Sections H-A 82
C-D 56
D-H 218 356

Available pressure head 274 m. i.

Section	B. T. U.	Feet Elbows	Assumed Diameter, Inches	Unit Friction.	Total Friction
		12.0		5.7	68
AE	20,000	0	1½		
		5.7		8.4	47
E2	8,000	6.5	1	15.5	101
		2.67		8.4	22
2C	8,000	7.5	1	15.5	116
Total					354

Section	B. T. U.	Elbows	Selected Diameter, Inches	Unit Friction	Total Friction
		12.0			68
AE	20,000	0	1½		
		5.7			47
E2	8,000	6.5	1		101
		2.67		2.1	6
2C	8,000	7.5	1¼	5.0	38
Total					260

The calculated friction head is 14 m. i., or 2.2% less than the available pressure head.

Circuit III may be designed as explained for Circuit II.

In practically all systems similar to those shown in Figs. 12 and 13, the system with the reversed return is to be preferred to one with a direct return. One reason for this preference is that it is easier to design the system so that the friction heads are all practically equal to the respective pressure-heads. Another and very important reason is that circulation through the farthest radiator begins much earlier with the reversed-return system than with the direct-return system. In some of the larger gravity-flow systems, which were constructed with direct returns, circulation through the farthest radiator began several hours later than through the nearest radiator. In the earlier period of the operation, practically all the hot water was short-circuited through the radiators near the heater. It is evident that the calculated gravity flow cannot take place through any radiator until the flow riser of that radiator has been filled with hot water.

The next section will describe the design of a two-pipe system with over-head distribution and reversed return.

Summer Ventilation and Cooling of Office Buildings

How a Small Refrigerating Machine Was Used to Reduce the Indoor Temperature from 80 Deg. to 70 Deg. F. and to Maintain a Relative Humidity of 70 Per Cent.

By Peter H. Bryce, M. A.

A SUMMER or two ago the manager of a large printing establishment, whose office building had been equipped by the writer with a humidifying apparatus for winter use, said the offices would be perfect if a large office room some 40 ft. square could be made cool and comfortable in the summer time. This room has windows 10 ft. high on two sides, looking south and east. In the hot summer months, in spite of blinds, the temperature in this room climbs at times up to 90° F. As the writer had previously worked over the ventilation details of passenger ships going through the tropics, the problem appeared to be comparatively a simple one, since it had been found quite possible, when the Ottawa (Canada) city water temperature did not rise above 65° or 70°, being taken from a large river rising in the northern woods, to allow water to flow slowly through the hot water pipes of the heating system. This, of course, reversed winter operation of the system and, with closed windows, supplied a very pleasing solution of the cooling problem.

OBJECTIONS TO USE OF COLD WATER IN PIPES OF HEATING SYSTEM

But the scheme had two objections, the first being that to waste a public water supply during the dry weather of summer, if generally practiced, would tend to exhaust the water resources at a time when the largest amount was being used for lawn and street sprinkling and to increase the public cost of pumping; while the second was that it did not provide for any current of fresh air being brought in from the outside which would maintain a proper degree of freshness and humidity.

SELECTION OF REFRIGERATING UNIT

Hence it was decided to work out the 40 ft. x 40 ft. room problem along lines similar to those on which the winter supply of humidity in houses was based; namely, the capacity of air for moisture at different temperatures, and the application of a cooling effect by a mechanical refrigeration apparatus.

Luckily, a small refrigerator was found on the market, driven electrically, with an automatic thermostat, which could be set to keep the temperature of the cooling room or office at any desired point. Wishing to insure economy with efficiency, the writer tried to make use of every natural agency to lessen the temperature and to utilize the cooling effect produced by the ice machine to the greatest extent possible. To do this the following details were worked out:

MEASURES TAKEN TO INSURE ECONOMY WITH EFFICIENCY

1. To cut off the direct sunlight from all windows by awnings of white duck, this being both the best reflector and poorest absorbent.

2. To provide for the introduction into the room of outer air at four o'clock in the morning, when the summer air is at its minimum temperature and can hold the least water vapor.

3. To reduce the air temperature to the point where it will deposit moisture, when the saturation point is reached, by passing it into the room in the basement containing the refrigeration coils.

4. To transmit the cooled air into the office where it will rise in temperature and so increase its capacity for moisture and, by its forward movement, mingling with the warm indoor air, take up moisture and at the same time reduce the temperature to the desired point of 70° F.

5. To provide in the floor of the office return ducts from registers, placed in the four corners of the room, to lead the room air back to the coil room, where the air will become mingled with outer fresh air in measured quantities and with it be cooled, any excessive moisture being precipitated on the pipes, and so again pass into the circulation of the office, thus maintaining a continuous air movement throughout the whole day.

6. To insure, as in mechanical winter ventilation, that doors and windows be closed. This requires a given amount of cooling down by the ice machine.

FEATURES OF THE PROBLEM

To illustrate, any room similar to the office already spoke of may be taken, having a cubic capacity of 25,000 cu. ft., in which an air movement equal to one change per hour is sought. To effect this, it will be necessary to deliver air through a central inlet duct in the floor of the room having a capacity of 2 sq. ft. and an air velocity of 3.5 ft. per second.

As this is a low air velocity, it will be found in practice, with the inlet of outer air into the coil rooms along with the return air from the office, that a continuous current will tend to be set up, owing to the difference of temperature. But to insure a standard change of air it will be necessary to place a small electric fan in a duct beneath the floor to give direction to the current from the coil room into the office.

There was thus a definite problem to solve such as the following:

Assuming that outside air at 4 A. M. in summer drops to 70° F., and that the office air at that hour is 80° F., obviously the first thing to do is to open all windows and try to get the room temperature, by cross ventilation, to approximately 70°. Having accomplished this, all windows and doors must be closed to retain room coolness as long as possible. But soon the external air becomes heated and by 8

A. M., the work hour, the building is beginning to heat up. Assuming it would have again reached 80° had no cooling taken place, the problem is to supply enough cold air to remove from the room air into the cooling chamber sufficient heat to hold the temperature at 70°.

It is proposed to utilize for this purpose a 2-ton ice machine which will have a cooling effect about equal to 25,000 B.T.U. per hour continuously. As this happens to be the same figure as the cubic contents of the room, it is seen, other conditions remaining the same, that we could introduce that amount of air into the room hour by hour and so remove one degree of heat from each cubic foot of air.

Now, clearly, with the heating of wall surfaces and the number of heat units given off from the bodies of the office employees, each with a body temperature of 98.4°, it will not be possible to introduce that much fresh air from the outside with an ice machine of the above capacity. But modern teaching has already proven that there is abundant oxygen in ordinary house air for health purposes if it be kept of the proper temperature and humidity and in constant movement. This obviously becomes possible through the constant return of the room air through the floor registers to the cooling room, supplied with coils chilled by expanding ammonia or carbonic acid.

ESTIMATING THE HEAT PRODUCTION WITHIN THE ROOM

We have now to find some rule to estimate the heat production within the room. If the ordinary estimate be taken of one person to each 1000 cu. ft. of space, our room would have in it 25 persons. If at desk work, each would give off, as body heat, some 140 B.T.U., so that, in all, 3500 B.T.U. would be added to the temperature per hour from the bodies of the inmates. Assuming that, by direct heat radiation from the sun, twice as much heat is added to the air of the room, we have in this way 10,500 B.T.U. added that must be removed by cold air. Hence, to make the calculation easy on this basis, we can say that an equal amount of outside and of room air must be drawn each hour over the cooling coils of the ice machine, or an amount of fresh air equal to half the capacity of the room must be drawn in by the fan hourly and mingled with an equal amount of the air of the room, which has been brought into the cooling chamber.

Thus, if the air of the room, or outside, has reached 75° and has a relatively humidity of 75%, it will, if drawn into the cooling room, be cooled down and, at 69°, become saturated. Its excess moisture then begins to be deposited on the cold pipes. On the other hand, if it is driven into the office room by the fan and mingles with the room air, the relative humidity will rise again to a normal of about 70%.

A few further particulars may be added. Obviously, we have in this simple arrangement an apparatus designed to do a definite piece of work. The several factors are known and the variations in the amount of air brought in from the outside and from the office space can be definitely provided for by dampers in the ducts from the outside and from the office, which enter into the cooling room. They can readily be adjusted from the office where is placed a simple dry and wet-bulb thermometer to record both temperature and humidity. If comfort and efficient work through the long trying days of summer are so essential a desideratum in thousands of offices, we have in this a method, supplied at the cost of a few cents daily after the first installation, which will meet all requirements.

New Rules for Figuring Effect of Wind on Heat Losses from Buildings

Based upon heat loss coefficients compiled by various investigators and given in the accompanying table (Table 3), some interesting new formulas have been developed by Professor A. C. Willard, professor of heating and ventilation and head of the Department of Mechanical Engineering at the University of Illinois. They were presented in a paper read at the recent annual convention of the National District Heating Association.

After discussing the nature of the coefficient of heat transmission and giving the fundamental equations involved, Professor Willard develops the following formula for a simple wall x inches thick:

$$U = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2} + \frac{x}{C}}$$

and for a compound wall of several materials having thicknesses in several inches of x_1, x_2, x_3, etc.:

$$U = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2} + \frac{x_1}{C_1} + \frac{x_2}{C_2} + \frac{x_3}{C_3} + \text{etc.}}$$

In these equations

U = B. T. U. transmitted per hour per square foot of wall surface per degree difference between the inside and outside air temperatures.

K_1 and K_2 = inside and outside surface coefficients for the two materials in contact with air.

C = conductivity of building materials.

TABLE 1—SURFACE COEFFICIENTS (K_1) FOR VARIOUS BUILDING MATERIALS UNDER STILL AIR CONDITIONS.

The values in the table are B. T. U. per square foot of wall surface per hour per degree F. difference between the mean air temperature in the room and the inside surface temperature of the wall.

Building Material	Surface Coefficient K (Still Air) Harding and Willard
Asbestos (sheet)	1.40
Brickwork (ordinary)	1.40
Cement Plaster (finished)	0.93
Concrete	1.30
Corkboard	1.25
Glass (window)	1.50
Magnesia (blocks)	1.45
Wood (finished surface)	1.40
Average of all values	1.34

TABLE 2—FACTORS TO BE USED IN DETERMINING VALUES OF OUTSIDE SURFACE COEFFICIENTS (K_2) UNDER MOVING AIR CONDITIONS.

In each case the factor is based on still air coefficient (K_1) for same material. For conditions where the wind velocity is not known use the factor 3 or take K_2 and $3K_1$ for same material.

Wind Velocity in Miles per Hour	Multiples of K_1		
	Brickwork	Wood	Average
5	2.38	2.19	2.28
10	3.20	2.71	2.96
15	3.76	2.95	3.36*
20	4.22	3.02	3.62

* This is usually taken as 3 even.

TABLE 3—CONDUCTIVITY COEFFICIENTS FOR VARIOUS BUILDING MATERIALS.

The values in the table are in B. T. U. per square foot of wall surface per hour per inch thickness per degree F. difference between the two surfaces, for thoroughly dry materials. For use where air temperature difference on two sides of wall is about 70° and outside air is near zero.

Building Material	Coefficient of Conductivity C and Weight per Cu. Ft.			
	Harding and Willard		Peebles'	
Authority	Lb. per Cu. Ft.	C	Lb. per Cu. Ft.	C
Asbestos (sheet)	48.3	0.29		
Asbestos Board (corrugated)	20.4	0.48		
Brickwork	132.0	4.00[1]		
Concrete (Stone 1:2:4 Mix)	140.0	8.30		6.30
Cinder Concrete				5.20
Corkboard	9.7	0.32		0.30
Magnesia (board)	13.5	0.51		
Wood (Fir, ¾ in. thick)	33.4	1.00		
Yellow Pine Sheathing				1.00
Drop Siding				1.10
Pine Plank				
Maple Flooring				1.20
Oak Door				1.30
Wood Lath and Plaster				1.10
Metal Lath and Plaster				1.25
Gypsum Partition Tile				1.00
Pyrobar (gypsum)				
Gypsum Reinforced Roof Tile				1.20
Insulex (very light gypsum)				0.50
Cabot's Quilt				0.40
Insulite				0.33
Celotex				0.33
Keystone Hair				0.29
Hair Felt				0.25
Roofing Paper and Pitch				
One thickness building paper				4.20[2]
One course No. 2 tar felt				3.00[2]
Cornell Wall Board ⅜ in. thick				2.50[2]
Glass (act. glass 91.4% total area)		2.06		
Double Glass ½ in. air space (glass 69.3% total area		1.50[2]		
2 in. Tile, ½ in. plast. both surf		1.00[2]		
4 in. Tile, ½ in. plast. both surf		0.60[2]		
6 in. Tile, ½ in. plast. both surf		0.47[2]		
2 in. Tile, plastered as above and roofing covered		0.84		

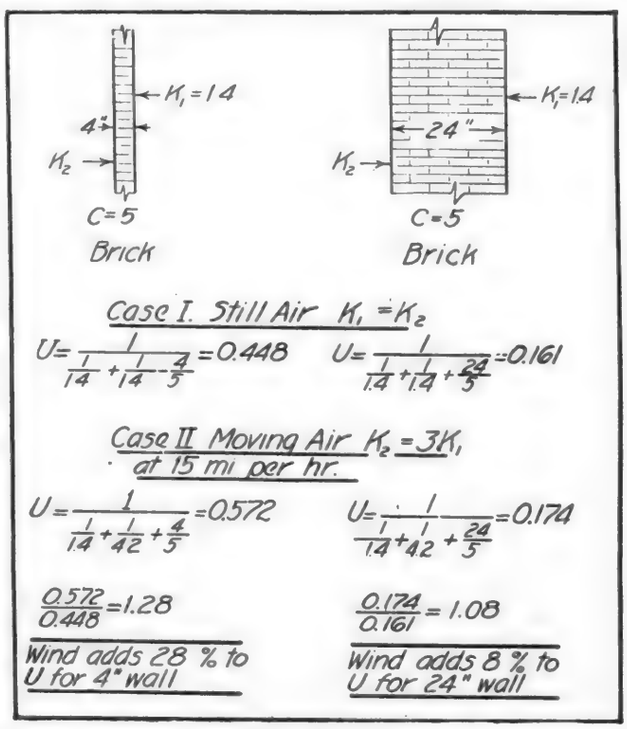
[1] For damp or wet brickwork take $C = 5$.
[2] Flat plate method using a test sample 18 in. square and up to 4 in. in thickness.
[3] For thickness and construction stated, not per 1 in. of thickness.

Using these equations, Professor Willard applied them to a few typical wall materials, such as brick and concrete, when the outside air was still and moving. In each case both a thin wall and a thick wall were investigated, and still and moving air coefficients for single-strength glass were also found. The computations for the two brick walls are given in Fig. 1, for the two concrete walls in Fig. 2 and for glass in Fig. 3.

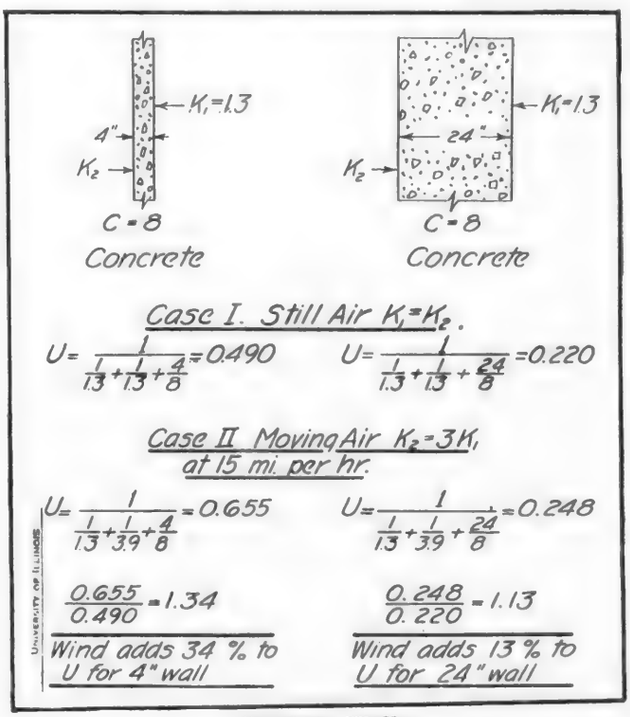
Table 4 is a summary of the results. Reference to the last column shows that the change in the heat transmission coefficient of a wall or glass produced by wind, as compared with the same wall in still air, not only increases with the velocity of the wind, but the increase varies widely for the same material depending on the wall thickness. In the cases investigated, the range of factors by which still air coefficients must be multiplied to correct for a 15-mile wind velocity is from 1.08 to 1.47.

An important point brought out by Professor Willard is that the effect of wind on heat transmission coefficients determined under still air conditions is very marked in the case of thin walls of any material, and becomes less and less important as the thickness of the wall is increased, until in the case of a very thick wall wind movement may be nearly negligible. Therefore, it is impossible and incorrect to apply the same constant correction factor to transmission coefficients based on still air or moving air conditions even for any one locality.

The only proper procedure, concludes Professor

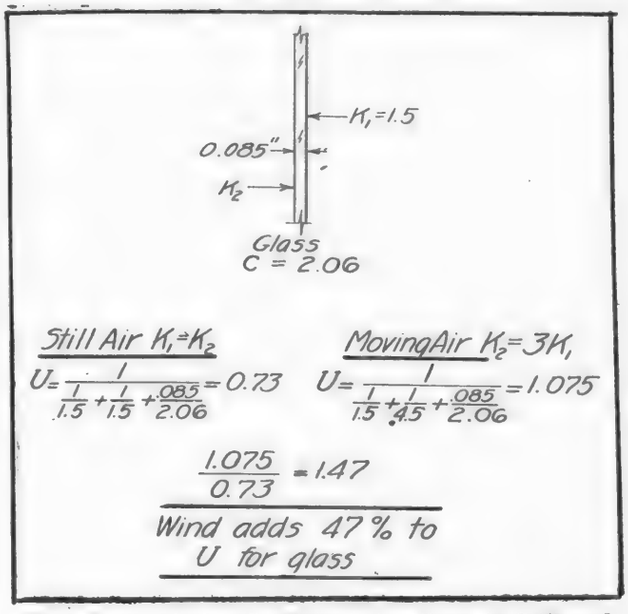

$K_1 = 1.4$
4"
K_2
C=5
Brick
$K_1 = 1.4$
24"
K_2
C=5
Brick
Case I. Still Air $K_1 = K_2$
$U = \frac{1}{\frac{1}{1.4} + \frac{1}{1.4} + \frac{4}{5}} = 0.448$
$U = \frac{1}{\frac{1}{1.4} + \frac{1}{1.4} + \frac{24}{5}} = 0.161$
Case II Moving Air $K_2 = 3K_1$ at 15 mi per hr.
$U = \frac{1}{\frac{1}{1.4} + \frac{1}{4.2} + \frac{4}{5}} = 0.572$
$U = \frac{1}{\frac{1}{1.4} + \frac{1}{4.2} + \frac{24}{5}} = 0.174$
$\frac{0.572}{0.448} = 1.28$
Wind adds 28 % to U for 4" wall
$\frac{0.174}{0.161} = 1.08$
Wind adds 8 % to U for 24" wall

Brick Walls


$K_1 = 1.3$
4"
K_2
C = 8
Concrete
$K_1 = 1.3$
24"
K_2
C = 8
Concrete
Case I. Still Air $K_1 = K_2$.
$U = \frac{1}{\frac{1}{1.3} + \frac{1}{1.3} + \frac{4}{8}} = 0.490$
$U = \frac{1}{\frac{1}{1.3} + \frac{1}{1.3} + \frac{24}{8}} = 0.220$
Case II Moving Air $K_2 = 3K_1$ at 15 mi. per hr.
$U = \frac{1}{\frac{1}{1.3} + \frac{1}{3.9} + \frac{4}{8}} = 0.655$
$U = \frac{1}{\frac{1}{1.3} + \frac{1}{3.9} + \frac{24}{8}} = 0.248$
$\frac{0.655}{0.490} = 1.34$
Wind adds 34 % to U for 4" wall
$\frac{0.248}{0.220} = 1.13$
Wind adds 13 % to U for 24" wall
UNIVERSITY OF ILLINOIS

Concrete Walls

Heat Transmission Coefficients for Walls of Two Thicknesses in Still and Moving Air



Heat Transmission Coefficients for Glass in Still and Moving Air

Willard, is to determine the probable wind velocity for the locality in question (based on Weather Bureau records for a period of years) and then compute the values of the heat transmission coefficient U for the velocity, selecting the inside surface coefficient K_1 and the coefficient of conductivity C from Tables 1 and 3, making the outside surface coefficient K_2 as much greater than K_1 as the wind velocity demands. If this proves too laborious, an approximate value can be arrived at by assuming rather arbitrarily an average fixed wind velocity for the entire country.

TABLE 4—TABLE SHOWING EFFECT OF WIND ON HEAT TRANSMISSION COEFFICIENTS.

The increase in heat transmission, occasioned by a 15-mile wind, compared with the heat transmission in still air, is shown in per cent. in the last column.

No	Wall Material	Wall Thickness Inches	U (No Wind) Still Air on Both Sides of Wall	U (Wind) Moving air at 15 Miles per Hr. on Outside of Wall	Increase in U, Due to Wind in per cent
1	Brick, plain.....	4	0 448	0.572	28
2	Brick, plain.....	24	0 161	0.174	8
3	Concrete 1:2:4 stone	4	0 480	0.657	34
4	Concrete 1:2:4 stone	24	0.218	0.248	13
5	Glass, no frame..	0 085	0 73	1.07	47

Note: The still air coefficients for the five cases shown would, therefore, have to be multiplied by the following factors: (1) × 1.28, (2) × 1.08, (3) × 1.34, (4) × 1.13, and (5) × 1.47. The use of the same factor for all five cases is indefensible and seriously incorrect.

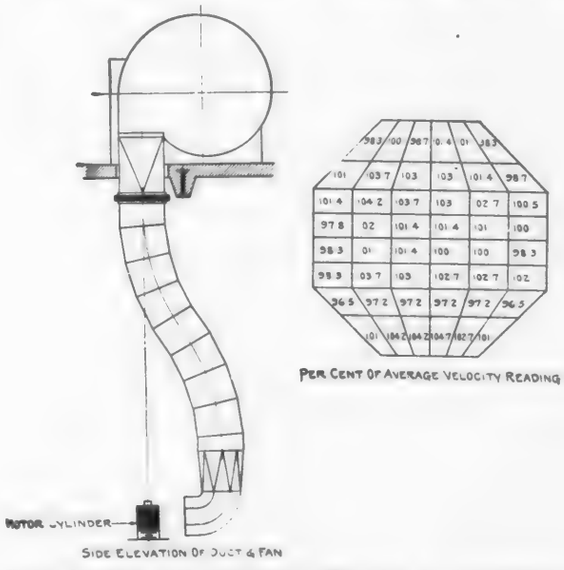
The direction of the prevailing wind during the heating season in any given locality should also receive consideration, but the effect of wind direction is far less marked on heat transmission coefficients than on infiltration or inleakage through cracks or openings in the windward sides of the building.

Novel Air Duct Design in Aeroplane Engine-Testing Laboratory

At the Navy Aircraft Factory, in Philadelphia, Pa., a large engine-testing laboratory is maintained, devoted exclusively to the testing of aeroplane motors. Obviously, the most satisfactory trial would be to subject the apparatus to conditions similar to those it will experience in actual operation. The motor in an aeroplane, for instance, cruising at a speed of some 100 miles per hour, is naturally working under very different conditions than when in a stationary position. To correct this factor, this testing laboratory at the Philadelphia Navy Yard is having installed a group of three fans to be used in supplying cooling air to the motor and thereby to create atmospheric conditions as near as possible to actual flying conditions. Their application in this particular instance has necessitated a unique construction of the duct system.

The installation, as described by Arthur L. Greene, of the Buffalo Forge Company, comprises three fan units, two of which are of the double duplex Conoidal type. The third is a small, special steel-plate blower, also of Buffalo Forge make. This latter unit has a capacity of 20,000 cu. ft. and is direct-connected to a 75 B.H.P. motor rotating at 1140 R.P.M. For present purposes a description of the duct design and construction used with this small unit will be sufficient.

The small fan mentioned will be used to supply cooling air to all single cylinder motors when undergoing trials in the laboratory. To test these motors under actual flying conditions, it is necessary that a current of air having a velocity up to 120 miles an hour—the maximum speed of planes equipped with



Duct Design and Operating Results of Aeroplane Engine-Testing Apparatus

these motors—be blown over the motor while running. This represents approximately 10,560 ft. per minute velocity. Under ordinary conditions, supplying 20,000 cu. ft. of air per minute at this velocity represents no special difficulty. The conditions met here, however, concern the unusual duct construction necessary because of the limited space provided for the fan units; this has necessitated placement of each fan with its motor on the floor above the testing room, while a duct leads downward from each blower to the testing block on the main floor.

In view of the importance of maintaining even air distribution over the surface of the engine, it is interesting to note the results attained in a test of this grid. The figures in each square or rectangular section represent the velocity pressure readings for that one section.

Back To First Principles

Plain Answers to Direct Questions on Present-Day Heating and Ventilating Practice

By T. W. Reynolds

(Continued From the June Issue)

36. *Q. Of what does the total heat of steam consist?*

A. The total heat of evaporation is the heat required to raise the temperature of the water from the freezing point to the boiling point, plus the heat required to change the water into steam at the pressure corresponding to the boiling point. It consists of the heat of the liquid and the total latent heat, the sum of which is equal to the sum of the heat of the liquid, plus the internal and external latent heat, or as detailed in previous paragraphs, the total heat is equal to the sum of the heat required to raise the temperature of the water, plus the heat to separate the particles of water against cohesion, plus the heat necessary to overcome the pressure of steam as it opposes the increase in volume.

Though the total heat of steam is measured above 32° F., the same as the heat of the liquid, yet it is many times larger, as the latter contains only the heat necessary to raise the temperature. For example, of the 1150 B.T.U. in the total heat at 212° F., only 180 B.T.U. are contained in the heat of the liquid, the balance of 970 B.T.U. being contained in the latent heat (See Fig. 23).

Each steam pressure has a corresponding total heat. The amount increases but slightly with the pressure. For example, the increase in total heat from 0 lbs. to 150 lbs. gauge pressure is only 45 B.T.U. This increase is due to the heat of the liquid which increases more rapidly than the decrease in latent heat (See Fig. 25.).

37. *Q. What is the lowest temperature and pressure at which water can be evaporated?*

A. Unbelievable as it may seem at first thought, steam can be generated from ice at the freezing point of water without any intermediate step such as the conversion of ice into water. As it is obvious that there is no heat of the liquid at the boiling point of 32° F., it will be readily seen that the ice would flash directly into steam as soon as it was supplied with the heat equal to the sum of the latent heat of fusion (the heat necessary to change a solid to a liquid) plus the latent heat of evaporation (See Fig. 23).

Fortunately for us this can take place only at the low absolute pressure of 0.0886 lbs. (very high vacuum of 29.82 in.), as at this pressure the resistance to change in volume is very slight. If our atmospheric pressure were 0.0886 lbs., instead of 14.7 lbs., there would be no water on the earth, though plenty of ice or steam.

Tables giving the properties of steam show this to be true. At the temperature of 32° F., the pressure is 0.0886 lbs., the latent heat and the total heat are the same (1073 B.T.U.), the heat of the liquid zero, and the temperature of the steam and water 32° F. Incidentally, the space required by 1 lb. of steam at this temperature and pressure is 3294 cu. ft., a volume which is very large, as compared with steam at other pressures (See Fig. 26). However, up to about 1 lb. absolute pressure the volume reduces at a rapid rate (See Fig. 25). Above this point the volume of steam is decreased with much less rapidity as the pressure rises.

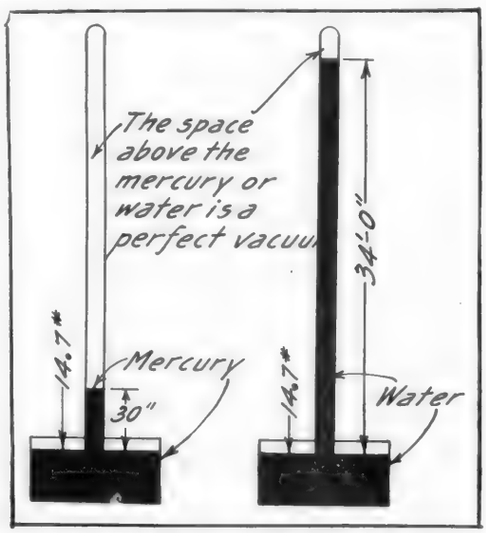


Fig. 27—Effect of Atmospheric Pressure Upon Liquids of Different Weights or Densities

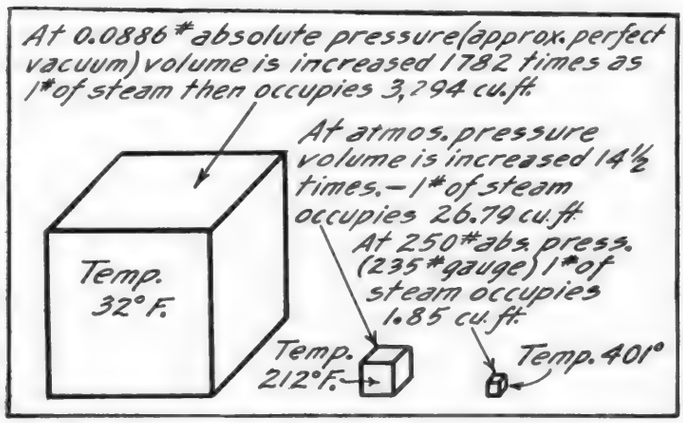

At 0.0886# absolute pressure (approx. perfect vacuum) volume is increased 1782 times as 1# of steam then occupies 3,294 cu. ft.
At atmos. pressure volume is increased 14½ times.—1# of steam occupies 26.79 cu. ft.
At 250# abs. press. (235# gauge) 1# of steam occupies 1.85 cu. ft.
Temp. 32° F.
Temp. 212° F.
Temp. 401°

Fig. 26—Comparative Volume of Steam at Different Pressures, Showing Enormous Increase in Volume at a Perfect Vacuum

38. *Q. What is the cause of atmospheric pressure?*

A. Our atmosphere extends for 50 miles or more above the earth, so that the total weight of the air above one square inch of the earth exerts a pressure at the lowest point (sea level) of 14.7 lbs. per square inch. Obviously, the pressure of the atmosphere or weight of the air is less at the top of mountains than at sea level.

39. Q. What is the difference between absolute pressure and atmospheric or gauge pressure?

A. There can be no confusion in our minds regrading the two pressures if we remember that gauge pressure is measured above a zero point placed at 14.7 lbs., absolute pressure (the pressure of the atmosphere), while absolute pressure is measured above zero pressure at perfect vacuum, or entire absence of atmospheric pressure.

In the usual steam-pressure gauge, the pressure acts on the interior of a tube bent in an arcuate form. The tendency of the pressure to straighten this tube out is opposed by the atmospheric pressure acting on the outside of the tube, hence the gauge reads in pressures above that of the atmosphere, so when we speak of a pressure of 2 lbs. per square inch, we mean gauge pressure, or pressure above that of the atmosphere. In a boiler on which the gauge shows 2 lbs., there is really a pressure of 2 lbs. plus 14.7 lbs., giving a total of 16.7 lbs. absolute pressure.

40. Q. What is meant by inches of vacuum?

A. The confusion sometimes resulting from our conception of a vacuum is due to our existence under a pressure caused by the weight of the atmosphere and to which we have so adapted ourselves that it does not ordinarily seem as pressure to us. Only pressure above that of the atmosphere seem realistic, those below seem unnatural and are often viewed as minus pressures.

When the absolute pressure is below the atmospheric pressure we have a very confusing way of referring to such a condition as a vacuum, and as a further confusion, we do not measure the amount of vacuum or decrease below atmospheric pressure in pounds per square inch as we measure pressures, but commonly measure it as a difference of pressure equivalent to so many inches of mercury. So we have two measures of exactly the same pressure expressed in different terms, for example; 20 in. of vacuum might also be referred to as 4.9 lbs. absolute pressure.

Theoretically, water will rise in the suction pipe of a pump to a height of 34 ft. We say it rises because of "suction." Early philosophers said it rose because nature abhors a vacuum, but later it was found that water would not rise above this point even with a vacuum above the water. From this it was learned that nature's apparent horror of a vacuum did not go above 34 ft.

Toricelli then made experiments with mercury, as this is much denser than water, and found that the mercury would not rise to 34 ft., but instead only to 30 inches. At these heights, the two columns, though unequal in height, were equal to one another in weight, as each was balanced by the pressure of the atmosphere. This showed that atmospheric air had pressure due to its weight, therefore tended to break a vacuum or rush into any place of lower pressure; also, that the exact amount of this pressure of the atmosphere could be determined by the weight of a liquid (such as water or mercury) which the pressure held up.

Atmospheric pressure of 14.7 lbs. per square inch is equal to the pressure of a column of mercury 30 in. high, so that a perfect vacuum or no vacuum at all would be referred to as 30 in. of mercury, or simply as 30 in. of vacuum. If a glass tube over 30 in. long is filled with mercury and the open end closed by finger and dipped into mercury in a pan (as shown in Fig. 27) as soon as the finger is removed the mercury in the tube will drop until its top is 30 in. above the surface of the mercury in the pan. Knowing that one cubic inch of mercury weighs 0.49 lbs., we learn from this experiment that the atmospheric pressure is 14.7 lbs. per square inch because the pressure acting downward due to the weight of 30 in. of mercury ($30\times0.49=14.7$ lbs.) is balanced by the pressure of the atmosphere acting upwards.

As further evidence of the exact pressure of the atmosphere, a tube of sufficient length may be filled with water (see Fig. 27), instead of mercury, in which case the height of the column would be 34 ft., or 408 in., instead of 30 in., as water weighs only 0.036 lbs. per cubic inch and $14.7\div0.036=408$ in. Again, if the tube were increased in area from 1 to 2 sq. in. the volume and weight of water or mercury supported would be doubled, but the height of the column would remain as before. This is because atmospheric pressure is 14.7 lbs. per *each* square inch, so that the total pressure of the atmosphere (14.7 lbs.$\times$2) acting upwards on the *two* square inches at the lower end of the tube would counteract and balance the total pressure of the column (14.7 lbs.$\times$2) acting downwards over the same area.

Now if we open the upper end of the tube to the atmosphere, we break the vacuum in the upper end, as the air at atmospheric pressure will rush in. The mercury will then press downward with the pressure of its own weight (14.7 lbs.) plus that of the atmosphere (14.7 lbs.), so that the atmospheric pressure at the lower end of the tube, being counteracted by the atmospheric pressure at the upper end can no longer support the weight of the column; consequently, the water or mercury will leave the tube.

If the upper end of the tube were not broken, we could find still other ways of removing the mercury from the tube. For instance, by removing atmospheric pressure from the lower end of the tube, as by suction, a vacuum would be created at the lower end, so that with no pressure to support the weight of the column, the mercury would leave the tube. If the pan is closed and sealed against entry of air (atmospheric pressure) and the air in the pan gradually exhausted by means of a suction pump, or some similar appliance, the mercury will drop in the tube, until, with all the air exhausted (atmospheric pressure removed), there would be no mercury left in the tube above the surface of that in the pan. This would leave a perfect vacuum (or no pressure at all) in the tube and would be referred to as a 30 in. vacuum.

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IT IS very interesting to contrast the alluring arguments of the house-heating fuel-oil burning enthusiasts with the hard-headed comments of many of the heating contractors and engineers who are still far from being "sold" on the oil-burning proposition. On one hand we have the experiences of those who have long specialized in this field and who have become experts in their line, while, on the other, we have men to whom oil-burning may not be so much of a mystery but who, nevertheless, find themselves at their wits' ends to account for some of the experiences they have with oil-burning outfits.

At the recent convention of the heating contractors, for instance, after the experts had been heard from, the discussion got down to "brass tacks" and some very frank comments were made, which are reported on another page of this issue.

From the discussion, two outstanding points seem to be clearly established. One is that the servicing of oil-burning equipment is essential and that the heating industry is not at present prepared to render this service. The other is the general agreement among all the speakers that oil-heating is on the way and that we may confidently look forward to its continued progress for house-heating, as well as for those types of buildings where an operator is in charge.

The conclusions here given are those long ago reached by heating men on the Pacific Coast where oil-heating may be said to have originated. There the usual practice is for the heating contractor to install the piping up to the oil-burning equipment itself and, as a rule, the manufacturer installs his own apparatus. Some of the larger heating contractors have trained their men to do this work and have been able to reap an extra profit as a result. So that the tendency is all in that direction, but unless and until the heating contractor is sure of his ground and of the competence of his men for such work, the success of his installations and the progress of oil-burning will be better promoted by leaving the actual installation of the burners and the servicing of the equipment in the hands of the manufacturers.

TENTATIVE plans, we are advised, are now under consideration to organize a separate division in the Bureau of Foreign and Domestic Commerce of the Department of Commerce, to be known as the "Plumbing and Heating Division." The work of this division, it is stated, will be devoted entirely to the expansion of plumbing and heating sales. This will be done by making personal and mail surveys of the possible markets of this country and the developing of ways and means of successfully selling the millions of prospects. Such a movement has our hearty approval and we only hope that it will pave the way for a consideration by the Department of the needs of the heating and ventilating industry in the way of engineering research. As was reported in last month's issue, the committee of the American Society of Heating and Ventilating Engineers which was appointed to investigate the matter of raising an endowment fund for the society's Research Laboratory, asked to be empowered to go to the proper government officials with a view of having the government establish a Research Laboratory in heating and ventilation. If the Department is willing to spend money in developing the market for plumbing and heating supplies, it ought not to be such a far cry to secure its support for research work.

JUST how ambitious are the plans of the National Association of Master Plumbers for a scholarship in sanitary engineering may be seen from the subjects which have been assigned to this course. To mention only a few of them, they include principles of engineering practice, chemistry in its various branches, surveying, analytical mechanics, calculus, experimental hydraulics, heating and ventilating engineering, architectural engineering and sanitary engineering design. It is quite evident that the association intends to take the term "sanitary engineer" in its widest sense because, if carried out along the lines indicated, it will embrace not only the activities of the plumber, but of the heating and ventilating engineer and air conditioning engineer as well. The question suggests itself, why not go a step further and give the young sanitary engineer a well-rounded education by assigning to him a course in electrical engineering, a year or two of refrigerating engineering and possibly, a little civil engineering on the side. Speaking seriously, it will occur to most people in the industry that the plumbing trade is planning a pretty big jump in its status and that the danger will be in establishing too wide a gap between its present status and that to be looked forward to. As Ole's friend advised him when he was about to leap from a departing ferry boat to the shore, "Better make it in two yumps, Ole."

Pros and Cons of Fuel-Oil Heating For The Home

Those who heard the addresses of A. H. Ballard before the heating engineers' society last January and more recently before the heating contractors' association, at Atlantic City, must have been impressed with his rosy view of the future of this industry. As reported in THE HEATING AND VENTILATING MAGAZINE for February and June, 1924, Mr. Ballard made the prediction that eventually every home in the United States would be equipped with fuel-oil burning equipment.

At one of the later closed sessions, the subject was discussed at some length and the discussion is reported in full in the association's *Official Bulletin* for July, containing the convention Proceedings.

Supporting Mr. Ballard's view of the situation, Mr. De Rosa, of Utica, N. Y., declared that now was the proper time for the heating contractors to get into the fuel-oil burning field. However, he cautioned those interested to be careful which kind of a burner they adopted and to keep away from all types of gravity burners, also from burners that will burn only furnace or distillate oils.

"Sell only burners," he declared, "that burn oil by atomization and burners that will burn the heavier oils known as fuel-oil."

Mr. De Rosa said there are some oil-burner manufacturers who maintain schools for the benefit of their agencies where four-week courses are conducted, so that the manufacturers are developing experts in this line who may be called upon with confidence. He endorsed Mr. Ballard's statement that the most important thing of all, after the installation is made, is the servicing of the burner. "There isn't a burner on the market to-day," he declared, "that will require no service. You must be prepared to give the customer your best attention, and prompt service when he calls for it, hence the importance of proper installation."

Another angle of the matter was presented by Thomas J. Douglas, of Chicago, who said:

"I, too, like the gentleman who spoke previously, have gone into the oil-burning question quite a bit. My opinion of the oil-burning industry differs from his absolutely. This is an age of specialization in burning fuel-oil; it must be burned by atomization.

"It is necessary to have mechanical equipment, electrical equipment, and, in some cases, thermostatic equipment. The heating contractor is not equipped to service those items and the one surest way, to my mind, of putting the oil-burning industry on the 'blink' is to service the machines with incompetent men.

"I have in mind a dozen cases where oil burners were installed in Chicago and on account of their having been installed by incompetent men, sold by high-pressure automobile salesmen who promised anything to get an order, installed by men knowing only how to handle a wrench or a pair of pliers and then serviced by incompetent men, of course, they caused trouble.

"I believe this is going to be an important part of the heating industry and it will be as important as the building of chimneys in our coal-burning apparatus. The heating industry should do what it can to see that competent concerns, led by competent men specializing in that particular business, go into the game, take charge of it from the sales through the installation and right down through the servicing. We, if we wish to make our bit, can make it on sales. Most of the customers for whom I put in heating plants, residences, apartment houses, etc., when it comes to a matter of burning oil, installing an oil burner, think it of sufficient moment to ask our advice and in most cases accept our advice. In that way we can act as sales engineers on the proposition and see that they don't get into it too deep.

"But when it comes to our fitters servicing thermostatic equipment, gas pilot lights, the electric motor-driven device, and one thing and another with which our steamfitters are not now familiar (and it will take too long to instruct them) they can do a lot of harm."

Harry W. Lloyd, of Springfield, Mass., made the point that in the average home either the woman of the house or some servant looks after the fires, as a rule, especially during the day and that this is responsible for many of the poor results which have been secured with oil burning in the home. He stated that his company had made a few installations in churches, apartment houses, and other places where the janitor or fireman or so-called engineer could be trained and in those instances his company had had fair success.

Past President Stewart A. Jellett then presented his views on the subject.

"I am not as enthusiastic," he said, "on the burning of oil as the gentleman from Utica. The problem is very much wider than the selection of a burner. It takes ability to get a sufficient quantity of fuel-oil at all times, a uniform quality of oil at all times, the safety of the installation itself and the facilities for the delivery of the oil.

"I attended recently a meeting in Philadelphia called by the Oil Club. There were about 200 men present to discuss fuel-oil for the heating of homes. The meeting was called for that particular purpose. Among those who discussed the subject was Henry L. Doherty, probably one of the best-posted men in the United States on burning oil and gas, and Fire Marshal George Elliott, of Philadelphia. We found on investigating that there is no certainty of a sufficient supply of good-quality fuel-oil even along the Atlantic Coast. In Philadelphia at the present time one of the large refining companies has been buying oil from its competitors in order to maintain its contracts and has refused to sign new contracts for oil."

On the question of costs Mr. Jellett presented data to show that in one proposed installation, with No. 1 buckwheat coal at $6.75 a ton in the coal bins and with oil at 5 cents a gallon, the oil would cost $3000 a year more than the coal, after adding to the price of the coal the cost of handling the ashes. Thirty-two hundred tons of coal were figured on.

"The same is true," declared Mr. Jellett, "in house heating. You get more comfort out of oil, more uniform heating and you have no particular trouble so long as your thermostat works properly and so long as the oil is of uniform quality. If the quality changes and the burner gums up, your fire goes out and the service department is called upon.

"There are a great many boilers using light oils under boilers. This type of burner is advertised and pushed very hard. Most of them are a very serious menace. I know of one instance, a short time ago, where the pilot light attached went out, the pump went on, the oil ran over, volatilized, the vapor rising in the elevator shaft to a small gas jet kept for the convenience of the night watchman, and when the vapor struck it, part of the roof of the building went off and the whole rear went in.

"At the conference one of the gentlemen from New York made the suggestion that every small house should have a 50-gal. tank buried under the cellar floor. I asked him if he would start the winter with one-third of a ton of coal in his cellar. It is ridiculous.

"At this convention in Philadelphia after the use of fuel-oil was thoroughly thrashed out from every angle, it was the consensus of opinion on the part of oil men themselves they were not yet ready to face the situation satisfactorily, that they had not investigated it sufficiently to satisfy the public as to their ability to furnish oil of a uniform quality in sufficient quantities to meet the service demands. I suggested to them that they ought to go further than that and refuse to sell oil to a customer unless the equipment in the building met with their approval and that of the fire marshal and the insurance inspectors, that the oil companies should do the same as the electric companies, who will not turn current into a building unless the wiring has the approval of the Board of Underwriters or the city electrical inspection. A committee has been appointed to investigate the entire situation.

"The bulk of fuel-oil today is coming from Mexico. One oil company will tell you their oil is far superior to the oil of another company, but I am told it all comes out of the same storage tanks in Mexico. The quality of oil coming from the tanks is not always uniform and you do not get a uniform quality of oil

over any continued period of time and until the oil companies can give us a uniform oil and until we can get burners that will work satisfactorily (most of them do not)—we should not recommend the use of fuel-oil to our customers. I have been told there are over 1700 patents issued for oil burners and I think eight or nine have been approved by the Board of Underwriters Laboratory in Chicago. So you see we still are feeling our way.

"But the use of oil is coming. It has certain advantages in the lessening of work in the home and when we get an assured supply of oil of uniform quality and a proper service for delivery of oil and the proper oil burner—*fool-proof*—then I think we will have reached the time when we can all stand up and shout for oil. But I do not think we have reached that point yet."

Building a Concrete Box Around an Existing Steam Main

Late in the summer of 1923, in Sioux City, it was learned that the city was about to repave an alley in which there were 190 ft. of 16-in. low-pressure steam main. This line was installed in 1905. The insulation was standard 18½-in. x 5-in. wood log casing. In this 190 ft. of pipe are one double-expansion joint, one anchor special, one 90° ell and three flanged joints.

As far as could be learned, leaks from rusted nipples caused by the old practice of nippling out from fittings and bricking these nipples into the fitting housings, together with the leakage from the expansion joint and poor surface drainage, had reduced the wood-log casing to a handful of ashes at the expansion joint and to a mere shell at other places along the line.

The conditions as described and the method adopted of remedying them were presented by C. E. Murphy in a report of the Distribution Committee, National District Heating Association.

Test holes, stated the report, indicated that the pipe was in very good condition and it was found to be so when uncovered. This was fortunate, as the nearest 16-in. pipe stock was in Chicago, and the line had to be ready for service in forty-five days. 18½-in. x 5-in. wood log casing was quoted at $5.20 per lineal foot, f. o. b. Sioux City, with five weeks' delivery. 1½-in. asbestos-sponge felted, broken joint, sectional covering was quoted at $2.41 per lineal foot with two weeks' delivery. It was decided to use the sectional covering and concrete box construction.

A week before the covering was shipped, the trench was opened. Railroad ties were laid across the ditch on 8-ft. centers and ⅜-in. seven-strand iron wire was looped around the pipe and ties, and the weight of the pipe taken on these as the line was uncovered. The line was then brought to grade by driving wedges between the ties and the wire. A runway of plank was laid on these timbers to get material in and out, as the alley is only 16 ft. wide and the trench took 4 ft. of this, leaving 2 ft. on one side and 10 ft. on the other.

The top of the steam main is 4 ft. below the surface of the alley. The trench was excavated 12 in. below the bottom of the main. One line of 4-in. drain tile, which had been installed with the original installation, was still intact but considerably to one side of the line. Another drain tile was added to the opposite side. A 4-in. crushed rock sub-base was installed, topped by 4 in. of concrete, leaving 4 in. between the top of concrete base and the bottom of the pipe.

Rollers and saddles were cast at a local foundry. The rollers are 8 in. long by 3 in. in diameter at the end, and were cast to fit the curvature of the pipe. These were shimmed up against the pipe and imbedded in the concrete base on 10-ft. centers.

By the time the covering arrived the base had set up sufficiently to remove the iron wire supports. The covering was then installed. A spiral wrapping of 6-oz. duck was put on over the covering and sewed in place. Single-ply Rubbertex roofing was cut into strips long enough to go one and one-half turns around the covering. One side of this was brushed with a dissolving preparation which cut the finish on the roofing material, leaving a sticky surface much like tire cement. These strips were then wrapped over the canvas, leaving a complete half lap on top. The Rubbertex was held tight to the canvas by the regular pipe-covering bands, and when the sticky surface set, was tightly fastened to the canvas all round. There is some question as to the life of this roofing material under these conditions, but as the total cost of the material was only $30.00, it was installed as an experiment, the expansion joint man-hole offering a means for easy inspection.

Wooden strips 1 in. thick and 3 in. wide, parallel to and on each side of the pipe, were imbedded in the concrete base. After the base had set, these were removed, leaving a shoulder for the inner concrete box form and the concrete side walls of the box. The wall of the trench was used for the outside form on one side of the box.

The concrete box or housing is 24 in. square inside, leaving a 2-in. air space between the outside of pipe covering and the inside of wooden forms. The base, walls and top are 4 in. thick. The soil was quite firm and practically no shoring was needed.

Spouts were made of sheathing and placed so as to carry the rain water from the roofs of buildings abutting the job, to a place where it would not run into the trench. This was fortunate, as there were some heavy rains after the base was poured and before the covering was installed.

Most of the small heating companies have done very little, if any, main construction or large repair work and when they have, the work has been supervised by a specialist in that line. This job was supervised by the company's own maintenance men, who had had no previous experience with work of this kind.

The costs of the job were as follows, and should be representative of what can be expected on a small heating property under like conditions, and may furnish a basis for estimating the cost of repairs of a similar nature. The figures given do not include the cost of reconstructing the expansion joint man-hole or fitting housings. No charge is included for the use of tools, railroad ties or runway planking. All other material used was purchased for this job and is included in these figures.

The item of supervision includes the time of one general foreman at ninety cents per hour, and one labor foreman at sixty cents per hour.

The old paving consisted of two courses of brick laid on a sand cushion with no concrete base.

COST FIGURES INCIDENTAL TO JOB

Labor—

Carpenters	$ .72 per hour
Labor	.48 per hour
Teams	1.00 per hour

Material, Concrete—Jan. 2, 1924.

Sand	$2.10 per ton
Gravel	3.10 per ton
Rock	3.75 per ton
Cement	2.80 per bbl.
Lumber	48.00 per M.

	Total Cost			Cost per Lineal Foot		
	Labor	*Material*	*Total*	*Labor*	*Material*	*Total*
Supverision	$204 60		$ 204 60	$1.077		$1.077
Removing paving	19.86		19.86	.104		.104
Excavating	106 80		106.80	.562		.562
Removing log	39 60		39 60	.208		.208
Temporary support	20.64		20 64	.109		.109
Sub-base and drainage	57 54	$ 47 26	104.80	.303	$ .249	.552
Concrete	66.36	200 00	266.36	.349	1.052	1.401
Wood forms	147 09	117.75	264.84	.774	.62	1.394
Roller supports	19.26	36.28	55.54	.101	.191	.292
Insulation	109.17	533.27	642 44	575	2.807	3.382
Backfilling	86 64		86.64	.456		.456
Hauling	50 58		50.58	.266		.266
Misc. barricades, etc.	30 90	12.04	42 94	.163	.063	.226
Totals	$959.04	$946 60	$1905.64	$5.047	$4.982	$10.029

THE USE OF POWER FANS FOR NIGHT COOLING OF COMMON STORAGE HOUSES, by H. J. Dana, specialist in experimental engineering, is the title of an engineering bulletin (No. 14) published by the Engineering Experiment Station of the State College of Washington. The data apply particularly to the preservation of apples in storage.

Legal Decisions

Claim for Delay in Installing Heating Plant Disallowed

Action having been brought to foreclose a mechanic's lien for steam heating and plumbing in a three-story frame house, the defendants counterclaimed for delay in the installation of the heating plant. The contract was in writing, containing the provision that the contractor should not be obliged to set the boiler until sometime in the summer or before cold weather. It was not set until the following March and the last radiators were not connected until a year later in March 1921. The principal dispute was as to which party was responsible for the delay, the plaintiff contending that floors were not laid so that radiators could be finally installed on the second and third floors until the spring of 1921, and that finally some of them had to be installed upon blocks because the final flooring was not laid.

It appeared that the work of construction which was done without the employment of an architect or contractor, dragged slowly, and that the installation of the heating plant by plaintiff kept pretty close pace with it. The roughing-in work was done promptly, and the various fixtures, bathtub, lavatories and radiators were installed from time to time upon request of the defendants. No complaint was made by defendants on account of the delay in the installation of the heating plant, or that they had sustained any damages on that account, until the filing of the counter-claim in this suit.

The Nebraska Supreme Court, Wentz v. Frickel, 196 N. W. 639, held that the parties by common consent had disregarded the provision as to the time when the heating plant should be installed, and that the defendant's claim of delay and consequent damage was an afterthought having its origin in the situation brought about by the commencement of suit to foreclose mechanic's liens held by plaintiff and other parties. Judgment for the plaintiff was therefore affirmed.

Estimate Not to Exceed Certain Sum

Where one party, desiring certain work performed, requests another to submit an estimate of the cost, and the other submits an estimate that the proposed work will cost from $1,125 to $1,200, and offers to guarantee that the cost will not exceed $1,200 whereupon the first party directs the second party to go ahead and perform the work, the Nebraska Supreme Court holds, Bates v. St. Anthony's Church, 196 N. W. 638, that no contract for any specific sum arises and the second party is entitled to recover no more than the reasonable value of the services rendered but not to exceed the larger sum.

The State of the Ventilating Art in 1875

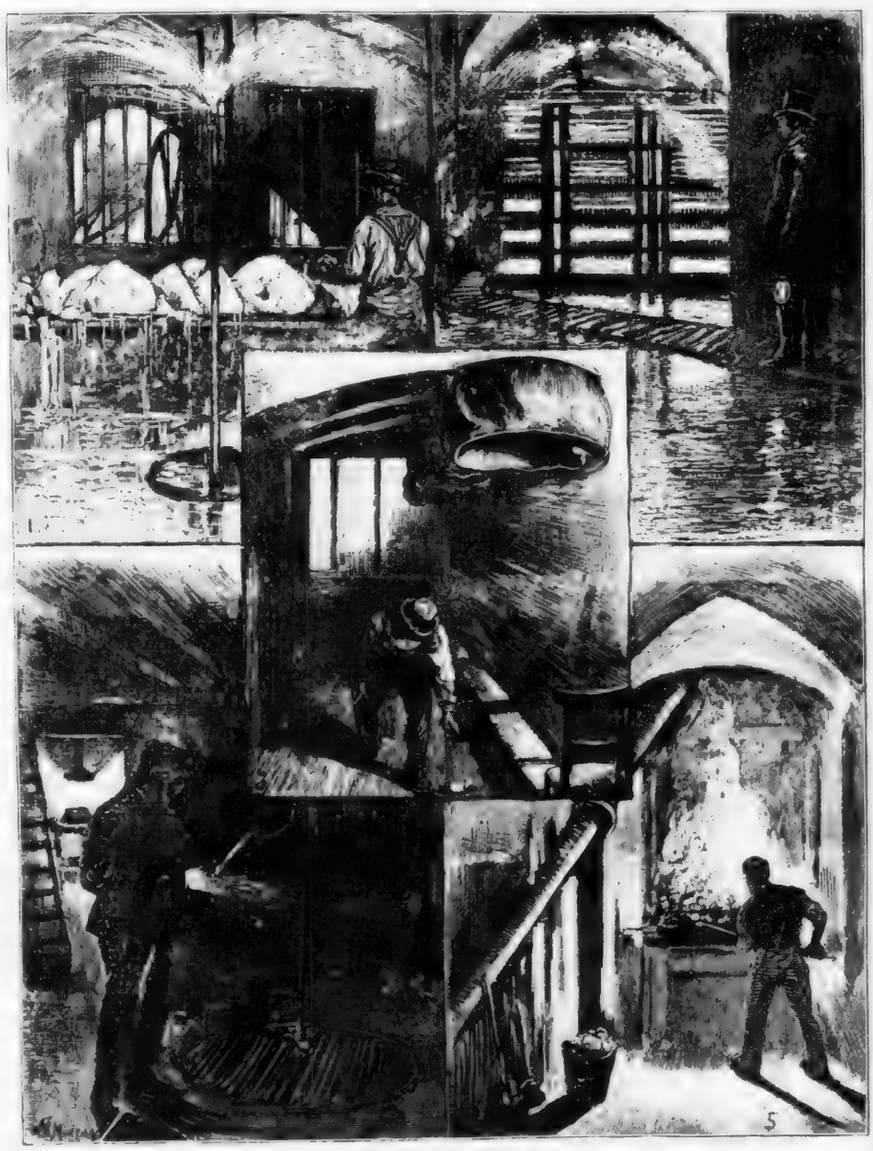
Evidence that cooling of buildings on an extensive scale was practised as early as the '70's is furnished in the accompanying reproduction of an article and illustrations which appeared in *Harper's Weekly* for August 21, 1875. In the light of present knowledge, however, the methods used form an interesting commentary on the art as practised at that early (?) date.

The article is entitled "Hot Weather Ventilation" and reads as follows:

"The above sketches show a portion of the arrangements for supplying the British House of Commons with cooled air during hot weather. The air is taken from the east terrace or river front of the Houses of Parliament, and is first drawn through a cooling chamber (Fig. 1), which contains ice. It is thence impelled by means of a slow-working machine in a vertical direction through the floor of the House. The quantity of ice consumed during a single sitting is small, only about three-quarters of a ton, as a very low temperature during hot weather is not desirable, the object to be attained being a constant movement of pure air through the House, while the atmosphere may be stagnant out-of-doors.

"In addition to being cooled by the ice, the air passes through fine sprays of spring water (Fig. 2), which not only precipitate all impurities but also tend still further to cool the air as well as to prevent dryness. The air then encounters a screen of canvas, which, owing to the action of the spray jets, becomes covered with a fine film of water, so that this canvas acts as a screen or filter on any floating dust which may have run the gauntlet of the spray.

"After the air has passed through this wall of canvas (Fig. 3) it rises in a vertical direction through circular openings in the ceiling, round which hang light canvas cur-



Scheme Used in 1875 for Cooling the House of Commons in London

tains which in rough or windy weather act as draught excluders by their collapsing on any sudden movement of the air, thereby closing the passage into the upper chamber. The attendant is shown in the act of picking up one of the papers which are sent down hourly from the House, and on which is recorded the temperature of every occupied portion of the building during the sitting of the House.

"The air in its upward course passes through eleven circular openings into a chamber immediately beneath the floor of the House (Fig. 4). Over each of these openings a thermometer and an anemometer are suspended, which enable the attendant to ascertain the temperature and velocity of the incoming air in all parts of the House. The air passes from this chamber through a perforated iron ceiling, which forms the floor of the House of Commons, and rises vertically through the paneled ceiling, whence the vitiated air is drawn by means of furnaces into upcast shafts. One of these furnaces (Fig. 5) is placed at the base of the clock tower, which forms a shaft 230 ft. high, the vitiated air being discharged at the level of the bells above the clock dials. The quantity of vitiated air which can be thus discharged during a crowded house exceeds 1,000,000 cu. ft. per hour, or nearly 7,000,000 gal.

Bid Blank for Use in a Cost Analysis of School Heating and Ventilating Equipment.

Commenting upon the accompanying bid blank, which was included in a paper by James J. Maher on "A Cost Analysis of Heating and Ventilating Plants in Schools," (published in THE HEATING AND VENTILATING MAGAZINE for July, 1923), the suggestion is made by J. M. Robb, of Peoria, Ill., that the blank should also provide for data on the cubical contents of buildings, as is done in the National Education Association standards, also for the number of class rooms and number of pupils, size and type of boilers, amount of direct radition, amount of Vento, size and number of fans, size and number of motors, amount of Vento radiation, with additional columns to show costs per cubic foot, as per National Education Association standards, and cost per equivalent square foot of radiation.

He further suggests that the Public School Building Operators' Association adopt such a form as a standard, and urge its members to use it in their accounting, as well as to report the compiled data to their annual meetings. In this way, it is felt, a fund of information would soon be collected which would be of value not only to the school operators, but to most heating and ventilating engineers.

ITEMS	Contract Sub-division	Previous Allowance	Gross Application	Balance
Brought forward,				
Heating and Ventilating				
" Main Boilers				
" Smoke Pipes				
" Grates				
" Boiler Setting				
" Boiler Trimmings				
" Coal Wagon				
" Fire Tools				
" Miscellaneous Tools and Cabinet				
" Damper Regulator				
" Hot Water Tank Regulator				
" Blow-off Tank				
" Hose and Rack				
" Gauges				
" Direct Radiation				
" Vento Radiation				
" Brass Pipe and Fittings				
" Iron Pipe and Fittings				
" Radiator Valves, Air Valves				
" Gate, Check and Globe Valves				
" Vacuum Pump and Motor				
" Vacuum Traps and Apparatus				
" Covering				
" Fans and Motor				
" Oil Burning Apparatus				
" Galvanized Ironwork				
" Automatic Control				
" Ironwork, Bars and Hangers				
" Painting and Bronzing				
" Labor				

Bid Blank Used by Boston School Building Department

Valuing Steam Heating Property for Rate Making

The North Dakota Board of Railroad Commissioners, in an investigation on its own motion into the rates of the Northern States Power Company, a combined electric, steam-heating and telephone utility operating in the city of Minot and immediate vicinity, found that the physical property of the electric utility is so interwoven with that of the steam utility that any valuation of one cannot be made independent of the other.

In making its valuation of the combined utility the commission allowed 15% for overhead expenses, and a return of 8% was allowed on the present fair value of the property.

The commission found that 5% was a reasonable allowance for annual depreciation of the steam-heating property, as compared with 4% for the electric property and 5% for the telephone property.

Steam-heating consumers in the city having in 1921 filed a petition for a reduction of 25% in the heating rates, alleging that the Minot rates were much higher than in other North Dakota cities, the commission in 1922, basing its valuation on historical cost, without consideration of reproduction cost new, established a schedule of rates reducing the general lighting and steam-heating rates. The federal district court, however, enjoined the enforcement of this schedule as confiscatory, the rates in effect prior to the commission's order being continued in effect. These rates, the commission by its present order, September 29, 1923, finds not unreasonable so far as the steam-heating department is concerned. Since the commission's first order the Supreme Court of the United States, in three decisions, Missouri ex rel. Southwestern Bell Telephone Co. v. Commission, 43 Sup. Ct. 544, Bluefield Water Works, etc., Co. v. Commission, 43 Sup. Ct. 675 and Georgia Ry. & Power Co. v. Commission, 43 Sup. Ct. 680, have made it clear that reproduction cost as of the time the inquiry relative to rates is being made must be employed in testing the rate, rather than the original cost of the utility property, that original cost alone cannot be adopted as the measure of value, but that prices prevailing at the time of the inquiry constitute a highly importment element to be considered, as well as other factors and circumstances, giving each such weight as may be just and right.

New Slide Rule Simplifies Design Work

The American Engineering Standards Committee has called attention to a newly-developed slide rule for standard parts, which was recently put on the market in Switzerland and was exhibited at the international standardization conference at Zurick. In the use of this novel aid to the draftsman and designer, the danger of making mistakes in transferring standard dimensions to drawings and computations is practically eliminated; and, furthermore, it is used more quickly and conveniently than the usual tables of standard parts.

A reprint giving a picture and detailed description of this slide rule is available upon request to the American Engineering Standards Committee, 29 West 39th Street, New York City, at whose office samples of the rule may be seen.

New Regulations for the Installation of Blower and Exhaust Systems

Stock and Refuse Conveying Systems

(*Concluded from July Issue*)

The system as considered in this class includes the suction inlets, fans, discharge ducts, and points of delivery, such as vaults and receptacles.

The high velocity of air and the flammability of the materials which these systems are usually required to handle, make them especially hazardous.

When practicable, the separation of flammable or explosive dust or stock shall take place before the dust or stock reaches the exhauster.

(In addition to the specific requirements for this class the general requirements apply.)

Fans

When flammable materials are passed through the fans the blades and spider must be of bronze or similar composition or the casing must consist of or be lined with such material. Ample clearance must be provided between the blades and the casing. The bearings of the fans must not extend into the housings or casings, nor into the ducts. Connections between discharge end of the fan and main duct must be made in such a manner as to prevent leakage of fine dust.

Ducts

Ducts for conveying stock or refuse, must be made of suitable non-combustible materials. All joints shall be secured and tight.

When ducts are made of sheet metal the joints must be riveted and soldered, except when lock joints are acceptable for longitudinal seams in pipes under suction. Spiral piping shall be riveted and soldered unless galvanized after the riveting. Every lap in the piping must be made in the direction of the air flow.

Metal ducts must be constructed of metal of not less than the following gauge:

8 in. or less in greatest dimension, 24 U. S. gauge.

9 to 20 in. in greatest dimension, 22 U. S. gauge.

21 to 30 in. in greatest dimension, 20 U. S. gauge.

30 in. and over in greatest dimension, 18 U. S. gauge.

Protection must be made for the wear due to friction at all points of change in direction by making long bends and using heavier materials, and where abrasive materials are to be conveyed, by using extra heavy materials or by inserting an approved form of inside lining that can be readily replaced. Where such lining is used the dimension of the pipe should be increased accordingly so as not to decrease the effective dimension of the duct.

All sheet-metal elbows must be made of metal from gauges heavier than the pipes to which they are connected.

Every bend, turn or elbow must be made with a radius in the throat at least equal to 1½ times the diameter of the pipe to which it is connected. A radius in the throat of twice the diameter must be used when space permits.

The main suction pipe shall preferably receive only one branch in the suction of uniform area wherever space permits, and in no case can it receive more than two branches in such a suction.

Every branch pipe must enter the main pipe at top or side at an angle not exceeding 45°. It shall incline in the direction of the air flow at the junction with the main pipe. Branch pipes must not project into the main pipe.

The main suction and discharge pipes must be made as short as practicable. They cannot be less than 6 in. above the floor at every point and not closer than 6 in. to any ceiling under which they may run.

Every pipe must be kept open and unobstructed throughout its length and no screen can be placed in it. The use of a trap at the junction of a hood and a branch pipe may be permitted provided it is not allowed to fill up with dust. Mechanical means for removal of sediment is recommended.

Suitable pipe fitting slide-out doors are permitted on all conveyor ducts at sufficient intervals to facilitate cleaning of ducts or removing obstruction.

Suction ducts must be provided on all machines, producing dust or combustible refuse and must be connected to exhaust fans.

"Sweep-up" pipes must be so installed or protected as not to admit materials large enough to damage the fan or cause obstruction in the ducts.

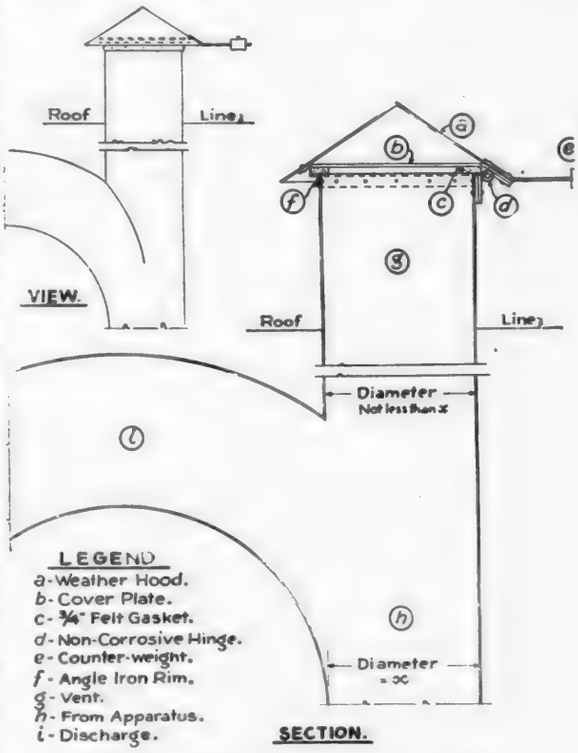
Trunk lines should be run on the outside wall of the building with ducts from each machine and each floor, passing out directly through the wall and discharging with the trunk line. If inside of building the trunk duct must be overhead, rather than under the benches; at least 6 in. from any combustible materials.

Cyclone Collectors or Separators.

The cyclones or separators must be outside the building when conditions permit, and so located as to constitute a minimum hazard to adjacent structures. Their construction and supports must be of incombustible material. It is recommended that they be provided with cleanout doors which will also permit the examination of the interior. If the cyclone of necessity is placed within 10 ft. of any combustible construction or unprotected openings into buildings, it must be provided with a metal vent pipe extending to a point above the main roof or other safe location.

Vents

All exhaust systems for conveying refuse or stock must be vented to the outside of the building, either directly —by means of the flues, by way of the separators, or by way of the bins or vaults into which they discharge. Such vents must be as direct as possible and of ample size. Discharge pipes must not come in contact with or expose combustible materials.



Suggested Form of Safety Relief Vent

Such vents must not be connected into chimneys, or pipes, vents or flues used for other purposes. If the air vent carries explosive or combustible dust, the use of a simple air washer, or other suitable filter, is recommended for eliminating such dust.

Screens are required to be placed at the outlets of open air vents to prevent the entry of sparks; they must not be attached when used at safety relief vents.

Safety relief, or explosion, vents are required on all systems used for conveying explosive or combustible refuse or stock. When taken off pipes or

flues they must be of at least the same cross-sectional area as the pipe or flue vented, and must be taken off ahead of the turns—never beyond. They must lead by the most direct practicable route to the outside of the building, never through adjoining buildings, and must not deviate more than 22½ degrees from the direction of the duct from which they lead.

The safety relief vent outlet should be provided with cowls or hoods, or, when non-escape of materials is essential with counter-balanced relief valves or covers, provided with soft felt gaskets at least ¾ in. thick. (See illustration).

Vaults and Refuse Receptacles

In the revised regulations regarding vaults and refuse receptacles, it is provided that separate vaults should be arranged for with blower and exhaust systems. Such vaults must not be used for receiving refuse or stock by other methods of conveying or by hand. Roofs of vaults must be provided with screened ventilated openings not less than 6 in. in diameter. Openings, if any, between vault and boiler room should not exceed 9 sq. ft. in area and bottom of opening should be not less than 6 in. above the level of boiler-room floor. Openings must be located at least 8 ft. from the firing door of the boiler, preferably at right angles to it and must be protected by standard automatic fire doors.

Refuse Receptacles

Where dust-producing machines are used only on a small scale, the dust or refuse, by special permission, may discharge into a substantial metal dust box located outside the building, in lieu of a vault. Such receptacle must have a self-closing door or cover which will readily open and vent a fire or explosion within. A receptacle not over 3x3x2 ft., adequate to care for the refuse, may be located inside the building. Such receptacles must be provided with ventilation directly to the outside air, with a clearance of not less than 6 in. between vent duct and combustible construction or materials. For reclaiming purposes a water tank may be used in lieu of a dust box. In such cases a steam coil or other approved means of heating must be provided where the tank is exposed to freezing temperatures.

Automatic Sprinklers

All metal parts of apparatus used in a refuse or stock-conveying systems considered in these requirements, including fans, ducts, etc., as well as shafting in connection therewith, must be electrically grounded. Belts must be grounded by means of copper collectors or "combs" connected to heavy insulated copper wires carried to "ground."

Automatic Sprinklers

In conveying systems in textile and knitting mills and similar occupancies, also in connection with apparatus used for similar purposes in other industries, approved sprinkler heads must be installed near the feed end and at the discharge outlet, inside the condenser, if such is used, and also a sprinkler to protect the blower. In some cases, sprinklers may be installed inside the ducts. Such sprinklers should be arranged in an offset or dome-shaped casing and not in the direct path of the draft. Sprinklers with smooth deflectors must be used.

Vaults must also be protected by approved automatic sprinklers. Where such protection is not available, steam jets may be installed or other approved means may be used for fire-extinguishing purposes.

Special Cases

Readily-ignitable stock, such as cotton, should not pass through the fan. The system must not be connected directly to picker or other hazardous machines. Systems handling such stock must operate entirely under suction with a device such as a "condenser," or large separating chamber to eliminate the stock from the duct before it reaches the fan. Such stock must enter the system in an upward direction and the pipe shall continue upward for at least 10 ft. to allow any heavy substances or foreign material in the stock to drop out. If the pipe must leave the room at a lower level, a long radius inverted U may be used to obtain the necessary vertical distance.

Systems using mixtures of cotton and wool which cannot be handled by condensers and which operate under fan pressure, must discharge to non-combustible rooms, bins or boxes provided with screened vents to the outside of the building.

When feasible, dust (refuse) from grinding, polishing and buffing wheels, sand papering machines, etc., should be discharged directly into special chambers without the use of separators, and the dust should be settled by spraying with water. This will obviate the hazard of dust in suspension within the chambers, as well as eliminate the necessity of special dust rooms for the mingling of such dust with coarser refuse within vaults.

The same procedure is recommended when dust (considered a byproduct and not refuse) is soluble in water or will not be affected by water, and can be reclaimed in this manner.

Lectures and Demonstrations on Plumbing and Heating Subjects

A three days' institute of lectures and demonstrations for members of the Pennsylvania State Association of Master Plumbers, will be held at the Carnegie Institute of Technology in Pittsburgh, Pa., November 11, 12 and 13, 1924.

The institute which will be conducted under the auspices of the Department of Heating, Ventilating and Sanitation of the College of Industries, will be free of any tuition charges, to members of the association. It is the first of the kind ever planned and is a significant step in the Institute's policy of lending its educational facilities to the needs of various industries.

The program for the institute has been arranged by S. E. Dibble, head of the department under whose auspices it is to be held, and will include lectures and demonstrations by members of the Carnegie Tech faculty.

Three lectures will be offered by Harold L. Lang, professor of biology and public health, on the topics of water supplies, sewage disposal and sewage gases. Others will be by Harry S. Hower, head of the Department of Physics, covering the subjects of heat and including such topics as temperature, heat quantity, heat capacity, latent heat, radiation, condition of solids, liquids and gases and convection by gases and liquids; three lectures by Prof. Robert B. Leighou, head of the Department of Industrial Science, covering metals and corrosion; three by Professor Dibble, covering tests conducted on a soil stack, flushing of water closets, demonstration and storage of hot water, presentation of the National Plumbing Code, and demonstration, showing direct application of lectures, in physics, hydraulics, and corrosion; and three lectures by Harold A. Thomas, professor in the Department of Hydraulics, covering the hydraulics of plumbing and heating.

C. F. Troutwine, president of the Pennsylvania State Association, has appointed Robert H. Pflug-Felder, Philadelphia, H. A. Kottcamp, Chambersburg, and R. M. Kilmoyer, Lebanon, as a committee to assist Carnegie Tech authorities in arranging for the institute. Others assisting include, George B. Stewart, first vice-president and John H. Keane, secretary of the Pittsburgh Master Plumbers' Association and C. B. Nash of the Standard Manufacturing Company. President Thomas S. Baker and Dr. C. B. Connolley, director of Industrial Relations of Carnegie Tech also, of course, are helping in plans for the course.

Pacific Northwest Chapter to be Organized

Favorable action has been taken by the council of the American Society of Heating and Ventilating Engineers on the petition of members in the northwest, headed by E. A. Stark, of Bremerton, Wash., for a chapter of the society covering the States of Washington, Oregon, Idaho, western Montana, western Canada and Alaska. It is to be called the Pacific Northwest Chapter. Those who signed the petition included W. D. Allen, C. H. Blackwell, Erwin L. Weber, E. O. Eastwood, C. F. Twist, W. J. Santmyer, W. A. Hill, W. R. McNeal, F. B. DeLong, F. H. Godfrey, C. G. Zokett, Seattle, Wash.; Robert H. Griffith, Portland, Ore.; E. A. Stark, William Mallis, Josiah C. Moore, Seattle, Wash., and Leslie L. Bysom, Bremerton, Wash.

Correspondence

Water Temperature Required for Different Outside Temperatures

EDITOR HEATING AND VENTILATING MAGAZINE:

We have been furnished with some interesting information on the proper water temperatures required to heat a building, as compared with the existing outside temperatures. We are attaching a copy of this table with the request that you state whether or not this information can be considered reasonably accurate. We realize, of course, that the construction of a building has a good deal to do with the ability to heat it properly, regardless of the outside temperature. But under normal conditions are these figures correct?

Minneapolis, Minn. C. R. M.

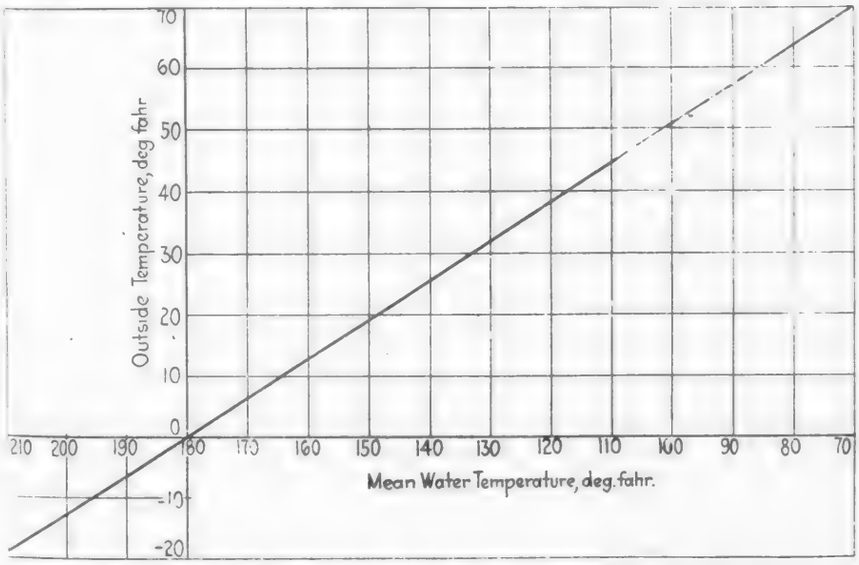
CORRESPONDENT'S TABLE OF PROPER WATER TEMPERATURE REQUIRED TO HEAT BUILDING AS COMPARED WITH THE OUTSIDE TEMPERATURE

Outside Temperature, Deg. F.	Temperature of Water Required to Heat Building, Deg. F.
60	100
50	120
32	140
20	150
15	160
10	170
0	180
10	190
20	200
25	210
30	220

REPLY

The accompanying curve is one which has been successfully used by an engineer who has specialized in water heating and which will give the desired information. The curve is based on a mean water temperature of 180° F., when the outside temperature is zero, and with a room temperature of 70° F. This point (0° — 180°) on the curve is variable, depending on the mean water temperature for which the radiation was sized. The fixed point on the curve (70° — 70°) is where the outside temperature and the room temperature are the same, in which case the mean water temperature in the radiator would also have to be the same, otherwise there would be an exchange of heat.

The actual water temperature at the boiler depends on the temperature difference the piping has been designed for or at which the system circulates. Assuming 30° difference between flow and return, the water temperature at the boiler would have to be theoretically 15° higher than called for by the curve, although an exact figure cannot be given, as the actual water temperature required depends on weather conditions, wind, exposure, etc.



Water Temperatures Required in Radiators for Different Outside Temperatures

Basing Economy of Fuel Upon Amount of Radiation Installed

EDITOR HEATING AND VENTILATING MAGAZINE:

There is a remarkable statement at the close of the article by Mr. Lane on the fallacy of "air change" factors, as published in your June issue, which, I think, should be corrected. Mr. Lane states: "Once the radiation is determined, it is an easy matter to calculate the amount of fuel necessary to keep the radiation at the proper temperature. Consequently economy of fuel consumption must be based on the economy of radiation installed."

I take it that the author means, by that statement, that in actual operation, a heat plant in a given building will use fuel in proportion to the amount of radiation installed, and that a plant that is installed with 100 sq. ft. less radiation than another, would use that much less fuel. The author draws this deduction from a theoretical calculation of the amount of fuel required to keep the radiators hot.

Of course, most such calculations are of only paper value and the actual fuel required to heat a building is something that cannot be computed in advance because there are a number of varying factors, any one of which may change for the better or the worse. Mr. Lane illustrates that fact himself in his discussion of air change and infiltration, but, even with the conditions of the building settled, different janitors will use a different amount of fuel for the same results.

A more important item in the economy of the heating plant is the ease with which it does the work, which would mean that the fuel consumption is inversely proportional to the amount of radiation installed. By way of illustration, suppose a man has to fire two hours in the morning to get his house warm. Another man in an identical house next door, with a larger heating plant, that is, one having more radiation, can warm his house in a half hour. We all know that a man with the smaller plant will burn more fuel, so that, instead of basing the amount of fuel required on the amount of radiation installed, the amount required depends as much or more on the time during which the plant must be operated to full capacity in order to heat the building. This is because when the plant is operated at full capacity there is a greater amount and a greater proportion of heat going up the flue than when the plant is operating with the drafts closed and a smouldering fire.

Kansas City, Mo. E. K. C.

Investigations in Heat Transmission

The National Research Council, through its Division of Engineering, has been requested to undertake investigations in heat transmission, the result of which will provide the designing, operating and research engineer with reliable information.

The first step in this inquiry was the appointment of a committee to make a careful digest of the available information on the subject, already published and otherwise, and to prepare a critical summary of such data. Sub-committees have been named to handle the many fields of engineering concerned under the following heads: heat transfers, fluids to solids; heat transfer, insulation; nomenclature and definitions; and temperature measurements.

The entire project will be administered by a small executive committee with these officers: W. H. Carrier, chairman, T. S. Taylor, vice-chairman, and H. Harrison, Brunswick-Kroeschell Co., 30 Church St., New York, secretary.

New Statistics on Central Station Heating in the United States

An idea of the extent of the central station heating industry in the United States and of the field covered by the average utility company is furnished in the answers to a questionnaire sent out by the Committee on Operating Statistics of the National District Heating Association. In addition to the usual information asked for, those companies doing water heating were furnished with a special questionnaire, to which seven representative replies were received.

Among other interesting items shown in the accompanying tables, may be noted the following:

Average number of customers per company, 318.

Steam sold per company, average, 322,000,000 lbs.

Steam sold per customer, average, 1,010,000 lbs.

Pounds of steam sold per ton of coal, average 12,400 lbs.; per barrel of oil, average, 2440 lbs.

Evaporation—steam sold per pound of fuel burned, average, 6.13 lbs.

Connected load, equivalent direct radiation in square feet, average, 685,000 sq. ft.

Heating requirements, pounds of steam per square foot of radiation per year, average, 498 lbs.

Mean temperature during heating season, 42.8° F.

Income per 1000 lbs. of steam, average $0.867.

Theoretical cost of fuel for producing steam with various fuels, using average results obtained from companies answering questionnaire. (All figures on a steam sold basis).

	Fuel		
	Coal	*Oil*	*Hog'd*
Unit of fuel	Ton	Bbl.	Unit
Weight of unit, lbs.	2000	336	4000
Steam sold per unit of fuel, lbs.	12400	2440	8533
Cost of fuel per unit	$5.24	$1.33	$1.24
Cost per 1000 lbs. steam (fuel only)	$0.423	$0.545	$0.145

Theoretical efficiency (steam sold basis) for various fuels.

	Fuel		
	Coal	*Oil*	*Hog'd*
Evaporation per lb. fuel	6.2	7.25	2.133
Average B. T. U. per lb.	12,100	18,515	4,435
Efficiency (factor of evaporation 1.1, per cent.)	54.8	42.0	51.5

Twenty companies, against four, favored the use of thermostatic control in the customer's premises. Fourteen companies favored welded pipe and thirteen, screwed pipe. Thirteen companies considered the business profitable at prevailing rates and twelve were of the negative opinion.

Territory served by water heating companies, average, 47 city blocks.

Customers served per block, average, 7.4.

Radiation demand, average, 320,700 sq. ft.

Average radiation per customer, 925 sq. ft.

Total pumpage, 3,550,616,931 gal.

Average pumpage per square foot of radiation per season, 2630 gal.

Coal requirements, for 2,030,417 sq. ft. connected radiation, 78,905 tons.

Average radiation connected per ton of coal burned per season, 25.7 sq. ft.

Theoretical efficiency, assuming 30° F. temperature drop between outgoing and incoming water and 12,000 B. T. U. heating value of coal per pound.

Heating requirements per square feet radiation per season:

$2,630 \times 8\frac{1}{3} \times 30 = 660,000$ B. T. U.

Heat delivered per ton of coal burned:

$25.7 \times 660,000 = 17,000,000$ B. T. U.

Average efficiency—71%.

Income per square foot of radiation, average, $0.386.

TABLE 2—FUEL DATA FROM 27 DISTRICT HEATING COMPANIES

No.	Fuel					Lb. of Steam Sold Per Unit of Fuel	System Loss, Percent	Lb. 1 Year Sq. Ft. Rad.	Labor, Average Cost Per Hr.	Average Income Per 1000 Lbs.	Mean Temperature	Evaporation, Steam Sold Basis	Equivalent Radiation, 1000 Sq. Ft.	Average Steam Per Customer, 1000 Lbs.
	Kind	Unit	Amount	Cost	B.t.u.									
1	Bit. Coal	Ton	139,855	5.92	13,300	12,630	18.8	485	$0.67	1.072	37.8	6.64	3,830	900
2	Bit. Coal and Coke	Ton	73,854	5.53	11,150	11,200	14.5	650	.761	.757	40.4	5.62	1,370	10,600
3		Ton	57,071	5.28		14,530	7.1			.605	36.1	7.27		6,930
4	Bit. Nut and Slack	Ton	62,077	4.66	13,000	11,770	20.5	551	.59	.57	43.2	5.88	1,330	2,010
5	South Illinois Bit.	Ton	60,682	4.51	11,500	9,100	24.4	330		.993	49.6	4.53	1,750	3,930
6	Oil	Bbl.	212,000	1.75	19,000	2,430	25.0	433	.60	1.24	45.7	7.23	1,190	1,840
7	Oil	Bbl.	41,288	1.14	18,044	2,894	21.4	516		.80	51.5		860	930
	Wood	Unit	38,070	1.31	4,370	8,533								
8	Bit	Ton	24,730	3.87	9,775	15,900	9.2	509	.55	.589	45.0	7.98	775	1,130
9	Illinois Screenings				9,500		20.0	637	.42	.497	45.0		365	495
10	Bit	Ton	21,134	4.37	12,255	10,327	30.1	488		.945	53.0	5 16	447	840
11	New River	Ton	13,290	7.90	14,635	15,600	14 4		729	.916	42.0	7.78		2,430
12	Bit. Slack	Ton	16,336	3.46	12,300	12,200	13.9	570	.505	.81	40.9	6.10	350	2,930
13	W. Va Nut and Slack	Ton	14,000	6.00	13,500	13,700	30.0	588		.96	35.4	6.87	327	430
14							30.0	400		.756	45.5		412	600
15	Slack	Ton	19,065	3.88	10,500	8,382	33.0	700	71	1.05	42.5	4.19	228	630
16	Bit Mine Run	Ton	11,617	5.52	13,900	12,900		470		1.36	44.7	6.74	319	518
17	W. Va. and Ky.	Ton	8,633	4.95	12,250	15,900	19.9	425	.45	.73	42.8		323	1,100
18	Central Illinois	Ton	8,712	5.67	11,500	14,900	15.0	574		.933	28.4		226	865
19	Hogged	Unit	25,610	1.16	4,500	4,760	26.8	665		1.13	42.0		183	596
20	River Coal						25.0	500	.50	1.01	13 0		230	456
21							12 7	500		.951	40.0		193	806
22	W. Va. Screenings	Ton	8,642			10,240	6 5	453		1 147	38 1	5.12	195	1,090
23	Oil	Bbl			18,500				70	1 03	26 0			626
24	Oil	Bbl.	20,585	1 10		2,540	32 8			1 00	58 0	7 57		656
25	New River	Ton	1,880	8 68	14,000		17.5	630		92	34 0		75	2,110
26							27.2			54				271
27	Bit	Ton	2,305	2 46	9,000	14,900	26.7	406	55	846	45.0	7.45	85	277

TABLE 1—CENTRAL STATION STEAM HEATING STATISTICS

STEAM HEATING—1923

No.	Number of Customers	Number of Meters			Pressure at Customer Service Valve			Steam Produced 1000 Lbs.	Steam Sold Per Annum 1000 Lbs.			Max. Hour 1000 Lbs.	Load Factor Percent
		Cond.	Flow	Total	H.	L.	Av.		Live	Exhaust	Total		
1	2,057	2,120		2,120	125	2-35		2,285,980	1,856,700		1,856,700	836	25 3
2	84	55	59	114	150	70	122	1,041,906	891,028		891,028	360	28 3
3	120	121	35	156	110	3	100	893,320	800,000	30,000	830,000	232	40 8
4	364	461	8	469	175	5		919,889	730,635		730,635	393	21 2
5	146	192	40	232	115	2		795,280	574,588		574,588		
6	280	469	2	471	15	1	3	690,000	258,000	258,000	516,000	350	16 9
7	478	827	1	828	29	1	10	565,465	325,271	119,027	444,298	251	20 2
8	351	490	2	492			5	434,730	394,910		394,910		
9	470	474	1	475	15	1		290,000	232,146		232,746		
10	260	216		216	3	1	2	313,719	218,254		218,254	152	16 3
11	85	58	24	82	40	15		241,788	206,972		206,972		
12	68	111	1	112	12	3	5	231,000	199,000		199,000	93	24 5
13	447	531		531	8	2	3	275,000		192,526	192,526	85	25 8
14	275	288		288	5	5	1.5	235,235		165,075	165,075	100	18 8
15	253	299	6	305	15	10	12	238,621	159,795		159,795		
16	290	313	2	315	15	1	5		150,039		150,039	125	13 7
17	124	127	3	130	80	1	1.5	171,023	15,010	122,206	137,216	65	24 1
18	150	154	2	156	15	1		152,804		129,875	129,875	75	19 8
19	204	237	2	239	15	7	11	167,000	121,836		121,836	90	15 4
20	252	274		274	12	2	7	153,500		115,073	115,073		
21	120	156	3	159	12	4	8	110,741	96,709		96,709	75	14 7
22	81	132	1	133	4	1	2.5	93,500	88,490		88,490		
23	87	93		93	5	1	3			54,449	54,449	18	34 5
24	80	77	3	80	6	3	4	77,881	52,319		52,319	50	12 0
25	22	20	2	22	60	0-7		57,000	47,006		47,006	25	21 5
26	149	149	1	150	5	1	2	55,419	40,352		40,352	17	27 0
27	124	141		141			4	46,907	34,360		34,360		

Year Book of Engineering Standards Committee

American Engineering Standards Committee, which serves as a national clearing house for industrial standardization and the channel of co-operation in international standardization activities, has issued its 1924 Year Book, a comprehensive discussion of the committee's work. It discloses that 152 projects are under way or completed, that 235 national bodies are co-operating in the work and that 1081 individuals are serving on sectional committees.

Among the projects of interest to the heating and ventilating industry which are being handled by the committee appear the following: Screw threads, sponsored by the American Society of Mechanical Engineers and the Society of Automotive Engineers; pipe threads, sponsored by the A. S. M. E. and the

TABLE 3.—CENTRAL STATION WATER HEATING STATISTICS

HOT WATER HEATING—1923

No.	Number of Customers	Area in City Blocks	Radiation Demand Sq. Ft.	System Make-up Percent.	Miles of Pipe	Different Pressure at End of Line		Max. Vel. Ft. Min.	Average Differential Customers Premium		Method of Regulating Water through Customers Premises
						H.	L.		Press.	Temp.	
1	765	75	970,275	2 03	34 0	50	1	615	14 0	35	Butterfly Valve
2	759	62	539,288	8 0	12 6	4	0	344	3 0	30	Orific Disc.
3	246	33	214,413	...	...	1	0	...	1 0	30	Gate Valves
4	225	96	212,000	...	5 5	...	...	...	2 0	8	Powers Reg. Valve
5	170	35	166,038	0 21	5 4	5	1	...	7 5	21	Thermostat
6	240	20	120,000	...	4 0	5	25	300	0 5	20	...
7	23	6	22,816	0 5	1 4	12	...	...	45 0	28	No

No.	Method of Heating Water			Average Pressure at Station		Pumpage Out of Station		Coal		Water Requirements Per Sq. Ft.	Average Income Per Sq. Ft.
	Live	Exhaust	H. W. Boiler	Out	In	Gal. Per Season	Average Gal. Per Hr.	Tons	Cost		
1	3rd	1st	2nd	71	14	2,382,532,131	160,020	31,676	...	2,445 gal. per season	$0 436
2	2nd	1st	...	55	5			25,063	$4 70	4 lbs. per hr.	.208
3	...	X	...	76	5	691,200,000	120,000	...	...	3,226 gal. per season	30
4	...	...	X	45	15			8,892	3 80	...	.36
5	2nd	1st	...	42	17	476,884,800	74,700	7,759	5 03	...	33
6	...	...	X	50	15		90,000	4,200		6 lbs. per hr.	.388
7	...	X	...	65	20		25,500	1,315	4 87	...	304

American Gas Association; pipe flanges and fittings, sponsored by the A. S. M. E., Heating and Piping Contractors' National Association, and the Manufacturers Standardization Society of the Valve and Fitting Industry; ventilation safety code, sponsored by the American Society of Heating & Ventilating Engineers; and engineering abbreviations and symbols, sponsored by the American Association for the Advancement of Science and the Society for the Promotion of Engineering Education.

Forced Circulation Water Heating System for a Large Apartment Building

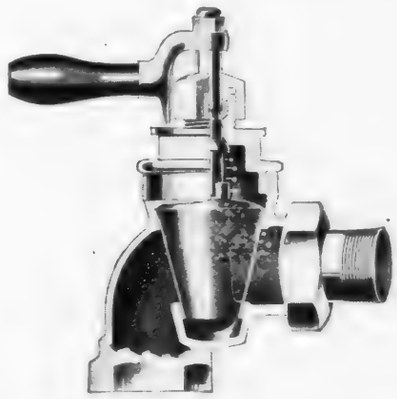
Due to the arrangement of the buildings themselves and to the numerous features of the heating equipment, unusual interest attaches to the installation of the forced circulation hot water system in the Hudson View Gardens Apartment Buildings, New York City. Bounded by Pinehurst and Northern Avenues, 182nd and 186th Streets, New York, and located across the way from Dr. Paterno's noted castle, at one of the most charming points along the upper end of Manhattan Island, the Hudson View Gardens present an impressive appearance. They consist of fourteen buildings, eight of which are six stories high, while the other six are four stories high.

Since a number of the buildings are entirely detached the heating problem required extensive study on the part of the engineer, George F. Musselman, to determine what would really prove to be the most economical heating system, with an eye kept out for maintenance charges, including the actual burning of coal. The engineer finally decided to use high-pressure steam boilers, due to their greater efficiency over low-pressure boilers.

The water is heated by the steam and forced through the entire plant by steam pumps. Thus it is seen that all working apparatus is confined to one building where it is under the supervision of the engineer. The pipe lines supplying the various buildings are run at a definite depth below the grade, regardless of the topography of the ground.

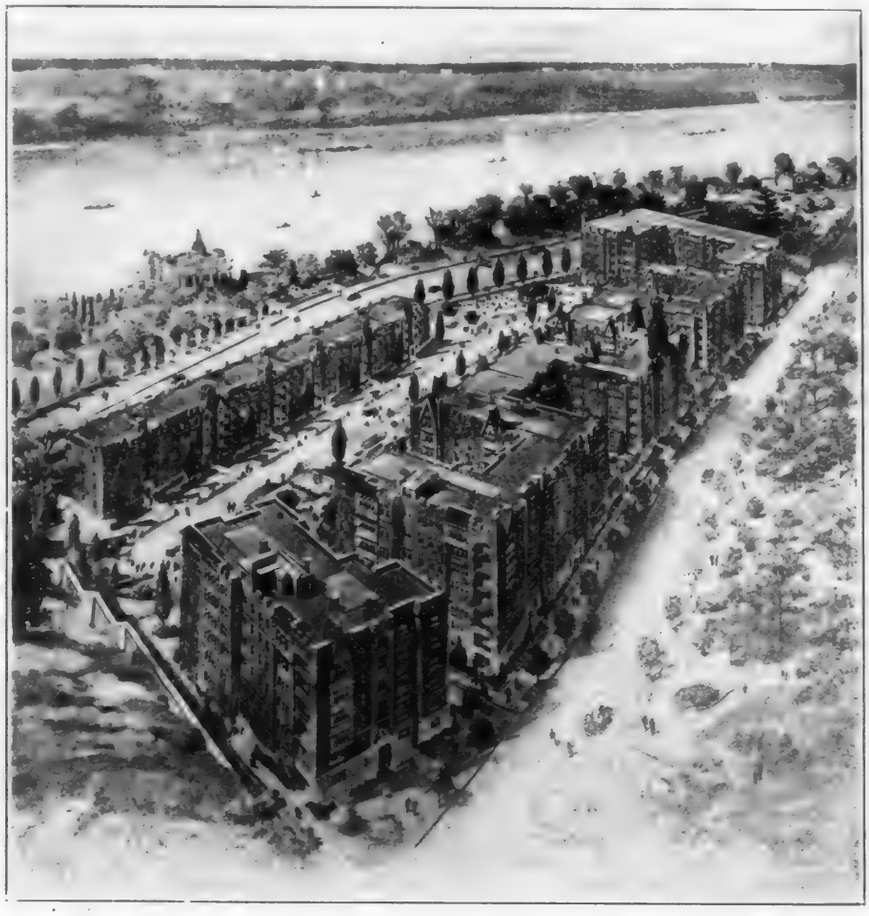
For this installation, which supplies heat to 356 apartments, the radiator valve selected was of the Gorton quarter-turn packing-lock type.

The adaptability of this construction is evidenced by the fact that a packing lock is obtained by grooving the stem and forcing the packing rings between the gland wall and the stem into the groove. For the composition disc, the mineral ingredients used have been selected as being impervious to corrosion, heat or disintegration. Another determining point in the selection of this valve for the Hudson View Gardens plant was its full-way opening, resulting, practically, in a long-radius elbow. This feature was considered important due to the fact that the hot water is forced through more than 1000



Construction of Gorton Quarter-Turn Packing-Lock Radiator Valve

valves. The reduction in the amount of friction is, of course, reflected in the amount of power consumed to obtain circulation.



Architect, George Fred Pelham, Inc. Consulting Engineer, George F. Musselman. Heating Contractor, J. L. Murphy, Inc.

Hudson View Gardens Apartment Buildings, New York

Bottom of Depression Reached

Early Readjustment of all Fundamental Factors and a Reawakening of Industrial Activity Throughout the Country

By L. W. Alwyn Schmidt

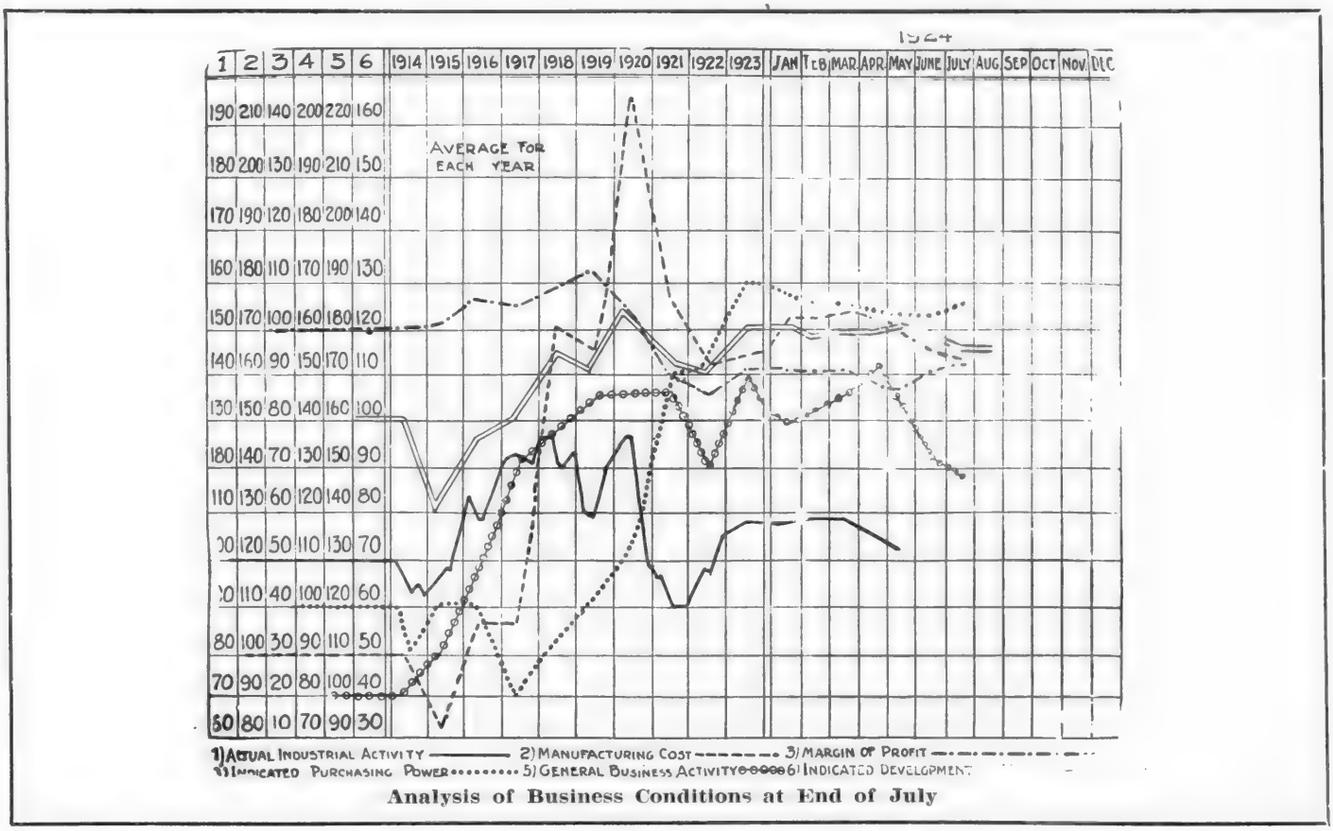
FOR the first time in the recent history of the market have appeared signs indicating the near end of the economic depression which has characterized the business activities of the nation since the ending of last year's high wave of prosperity. The bottom of the wave apparently has been reached and the waters are flattening out, collecting strength for the new upward movement. In the face even of still declining production figures we are inclined to predict an early readjustment of all fundamental factors and a reawakening of industrial activity all over the country.

July has brought its usual summer dullness and the chances are that August will not show any marked improvement. But it would be wrong to estimate the carrying strength of the market exclusively upon such evidence as appears upon the surface. The American market is still very largely an agricultural market. This, notwithstanding the fact that we are one of the largest, if not the largest, manufacturing nations of the world. So, while industrial prosperity has its bearing upon national market activity, it is, after all, the farming community and its wellbeing which provides the stimulus required for its healthy growth. To the farming community, therefore, we must turn for enlightenment as to the future development of the nation's business.

With the coming of August the Western and Southern farmers will be able to form an estimate of the possible earnings from their crops. These crops will be gathered inside the next few weeks and their marketing will begin. Financial activity, therefore, must show itself first in the immediate neighborhood of the farming centers. It will strike the small cities and will slowly move East and North, following the movement of the crops to the centers of consumption. At the same time manufactured merchandise will start to flow to the farming centers. The size of the movement will depend upon two factors: the quantity of the crops, —and its price. As the farming communities pay for their purchases practically exclusively with their crops, the volume of the crop movement is of considerable importance to the manufacturer. But even the largest crop movement can not be of value to the farmer if his profits are not sufficiently large as to leave in his hands a margin to take care not only of his most immediate needs but leave also something to spare for so called luxuries.

Judging from the reports from the farming centers it appears that the crops will be satisfactory. Prices appear to be high enough to secure a profit, especially as the purchasing value of the dollar for industrial products is again on the increase.

Much will depend now upon the ability of the country to pay for its crop, to move and to consume it. There have been years where lack of ready cash has seriously impaired the value of the crop movement for our national market. This year, however, the nation seems to be exceptionally well prepared to take care of this business of financing the crop. Banks have accumulated during the last months large funds which can be made available for any desired purpose. In fact, it is said that the banks will welcome very much an opportunity for setting into motion the cash resting in the Treasuries. Owing to the industrial depression the movement of industrial merchandise has been small, requiring only little financing. The money has remained in the banks and it will come very handy for the crop movement, securing a smooth flow with cash payments at every stage. The cash paid to the farmers, in turn, will be at the disposal of country bankers. It will take care



Analysis of Business Conditions at End of July

of the requirements of local dealers who will be enabled to finance their merchandise transactions. These transactions should be rather heavy because the farming communities have been very much understocked all through the summer and will want great quantities of merchandise to take care even of normal requirements.

With many of the indications for a return of prosperity clearly visible it is to be wondered why this prosperity has not come much earlier. An answer can be readily found. The present state of economic stagnation has had no real foundation in fact. There was no general but only a partial economic depression. The building industry has been active. The luxury industries, like the perfumery industry, have done well. Individual earnings have remained upon comparative high levels. Money has been plentiful and easy. Nevertheless there has been a slackening down of the manufacturing industries. Banks have been slow in making industrial loans. Railroad loadings have been behind the usual figures. The steel industry is seriously flopping, and, last, but not least, merchants and manufacturers alike are complaining about slow collections.

Somehow the nation appears to have made up its mind that business would be slow during the present year and, having once adopted this point of view, it proceeded to make sure of its presentiment by simulating all the outward signs of an economic depression. Where there was reason merely for caution, overcautiousness appeared and what might have been a passing flurry just failed to be turned into a real crisis by the fact that even the most susceptible market can not be depressed permanently by a mere attack of nerves. Incidentally this also is a presidential year with the election still ahead of us.

If the present condition of the market, with its outward appearance of an economic depression, is largely a state of mind, it follows that the market being fundamentally sound, it may just as rapidly turn to a more cheerful appraisal of the situation. A sudden change, therefore, is not only likely but practically certain, and, with conditions being what they are, this change can not be deferred very much longer. The weather, which had much to do with the slackness in the late Spring and early Summer, has now settled to its more regular Summer routine, and with it business appears to have become more steady.

The crop movement will do its share in this development. Local merchants will change their present method of small stock in favor of larger and more varied selections. Money will enter circulation and the consumer will ask for merchandise.

This possibility of a sudden change to the better should be seriously considered by manufacturer, dealer and financier alike. Its coming will put unusual pressure on the much-depleted retail stocks of the country, resulting in an increased and sudden demand for merchandise that might easily overtax the facilities of the manufacturing industries and railroads. It may call for financial assistance in the manufacturing centers before the money now collected by the banks in the farming centers can be made available for industrial financing.

Unpreparedness for prosperity in such a case might be just as disastrous as unpreparedness against adversity. It is to be hoped that the great and exceptional resources of the nation will be handled wisely in this emergency which we will have to meet sooner or later.

Notable Building Project in Merion, Pa.

A building project in Merion, Pa., a residential district of Philadelphia, involving an expenditure of $651,600, is under way. The structure, which will be known as the Merion Manor Apartments, will be 3½ stories high, with basement, and will be built of concrete, steel and masonry. The building will comprise ten units of three apartments each. Steel frames and sash will be used for the windows, and ammonia expansion refrigeration will be supplied to the refrigerators contained in completely equipped kitchen cabinets. The building is described as in reality a group of private residences. The site is directly opposite the Merion station of the Pennsylvania Railroad. The construction is being financed through an issue of $430,000 first mortgage, 7% bonds, handled by G. L. Miller & Co., New York.

The Merion Manor Apartments will be equipped with the Webster vacuum system of steam heating, using upfeed risers. The vacuum will be maintained by a continuously-operating electric-driven duplex vacuum pump. Steam will be generated by two steel, fire-tube boilers, cross-connected in such a manner as to permit the operation of either one or both, as may be desired. This will permit the use of one boiler in the Spring and Fall, and both in the midwinter months. The boilers will be equipped with oil burners.

Details of the oil-burning system provide for a 3000-gal. storage tank buried under the garage floor, with a filling line run to a fill box at the edge of the driveway which leads down under the garage. The specifications were prepared by Starr & Selfridge, combustion engineers.

Each boiler will be equipped with two low-pressure atomizing burners and the hot-water service boiler will be equipped with one burner of similar type. The oil and air pumps which supply oil and compressed air to the burners will be in duplicate, with one set in reserve. The system will be installed with suitable boiler controls, designed to automatically start up and shut down the burners to meet variations in the heating load on the boilers. The hot-water service boiler will also be fitted with automatic control to maintain the water at the desired temperature.

All of the burners will be fitted with automatic gas pilot light controls. When the burners are not in operation there will be, adjacent to the boiler, a small gas flame which will burn at all times. When the boiler controls operate and start the pumping unit, this small pilot flame will light a long gas flame, which is cut in automatically and which is kept burning until the burners shut down.

In general, the oil-burning system is designed to eliminate the services of an attendant and to maintain automatically proper temperature in the hot water service system.

The boilers, as now installed, are of the straight-draft type, but are of sufficient capacity to allow of their being converted into smokeless coal-burning boilers at any future date.

The piping system has been designed to insure complete circulation with a pressure of 1 lb. at the boilers, in severe weather. The returns are graded back to the pump 1 in. in 20 ft. The radiation is of the warm-water type, plain pattern, cast-iron. Each radiator is equipped with a Webster modulation valve and a Webster Sylphon trap.

Each boiler also is equipped with a Webster damper regulator and a Webster combination vacuum and pressure gauge. The boilers and all supply mains and branches in the basement are insulated, as well as the concealed risers, which are run in inside partitions.

Thomas J. Lippincott, of Philadelphia, is the architect for this group of buildings.

Merion Manor Apartments, Under Construction at Merion, Pa.

Radiator Supply Valve Sizes

A well-known heating and ventilating engineer once said to me, while discussing various radiator supply valves for two-pipe vapor and vacuum jobs, "I dare say that the openings in any valve could be decreased by 50% and still be sufficiently large to supply enough steam to the radiator."

This remark was recalled to mind later on by a stunt which another engineer tried with success which would prove that not only was our friend right but, in fact, very conservative.

The engineer who made this practical test had a 52 sq. ft. radiator in his office supplied by a ½ in. valve of his own make. He placed a brass disc in the valve between the union spud and the valve body in such a manner that it was steam tight and through this disc he drilled a 5/16 in. hole. No readings were taken as to the exact time required to fill the radiator from a cold start nor were any definite readings taken to see if only a part of the radiator was full below a certain pressure, that is, it was not noted what pressure drop occurred through the valve.

It was explained that it had not occurred to him to go into detail in that matter for the reason that the radiator seemed to function exactly the same as it did before the disc was put in and he was satisfied from that fact that the hole was large enough to do the job. There is no doubt about that being so since the disc was in all winter and the office was just as warm as any preceding winter.

It occurred to me that the velocity of the steam through that hole must have been something remarkable so, to satisfy my curiosity, I figured it out backwards, so to speak, in this manner; assuming the radiator to be doing its duty by delivering 250 B.T.U. per hour per square foot, assuming, then, 1150 B.T.U. to the pound of steam, it would deliver 11.3 lbs. of steam per hour. Assuming this steam at atmospheric pressure there would be a total of 302.73 cu. ft. of steam per hour passing through this orifice 5/16 in. in diameter. The figures involved in finding the velocity from this basis are lengthy so I will not burden this sheet with them. However, the answer turned out to be 158 ft. per second. I feel that the reader is just as surprised as I was and expected to find a much higher velocity.

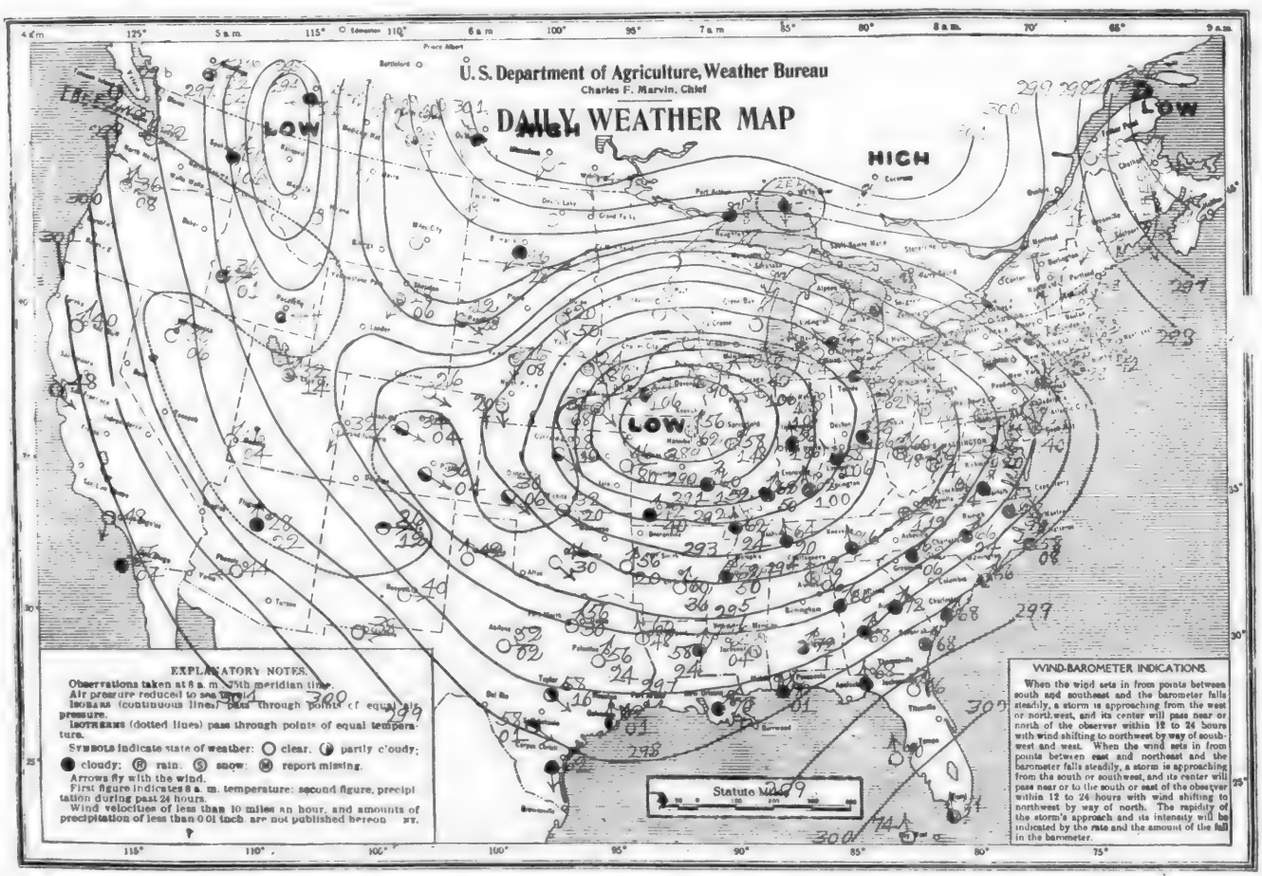
I presume the one thought in the reader's mind at this point is, how about the drop in pressure through this orifice. As I mentioned, there was no effort made to find this exactly but I am assured by the engineer that he noted several times that the radiator was completely filled with a pressure of 4 oz. at the boiler. The boiler was located some 100 ft. from the radiator horizontally and 15 ft. vertically.

At any rate, the result of this practical test should prevent anyone from worrying about the size of valves used on two-pipe work, especially where the valve is designed with a full pipe size opening unobstructed in any way throughout the valve, as naturally this type of value would offer no more resistance to the flow of steam than an ordinary elbow. Using this test as a basis, a ½ in. valve of this type is seen to be able to supply 150 sq. ft. of radiation with no trouble. This is readily understood when it is realized that for any given power or pressure behind the flowing medium the carrying capacity of any pipe or valve is limited only by the resistance offered to the flowing medium and its ultimate capacity is reached at the point where the friction engendered and the original power applied is equal.—GEORGE D. CHADEAYNE

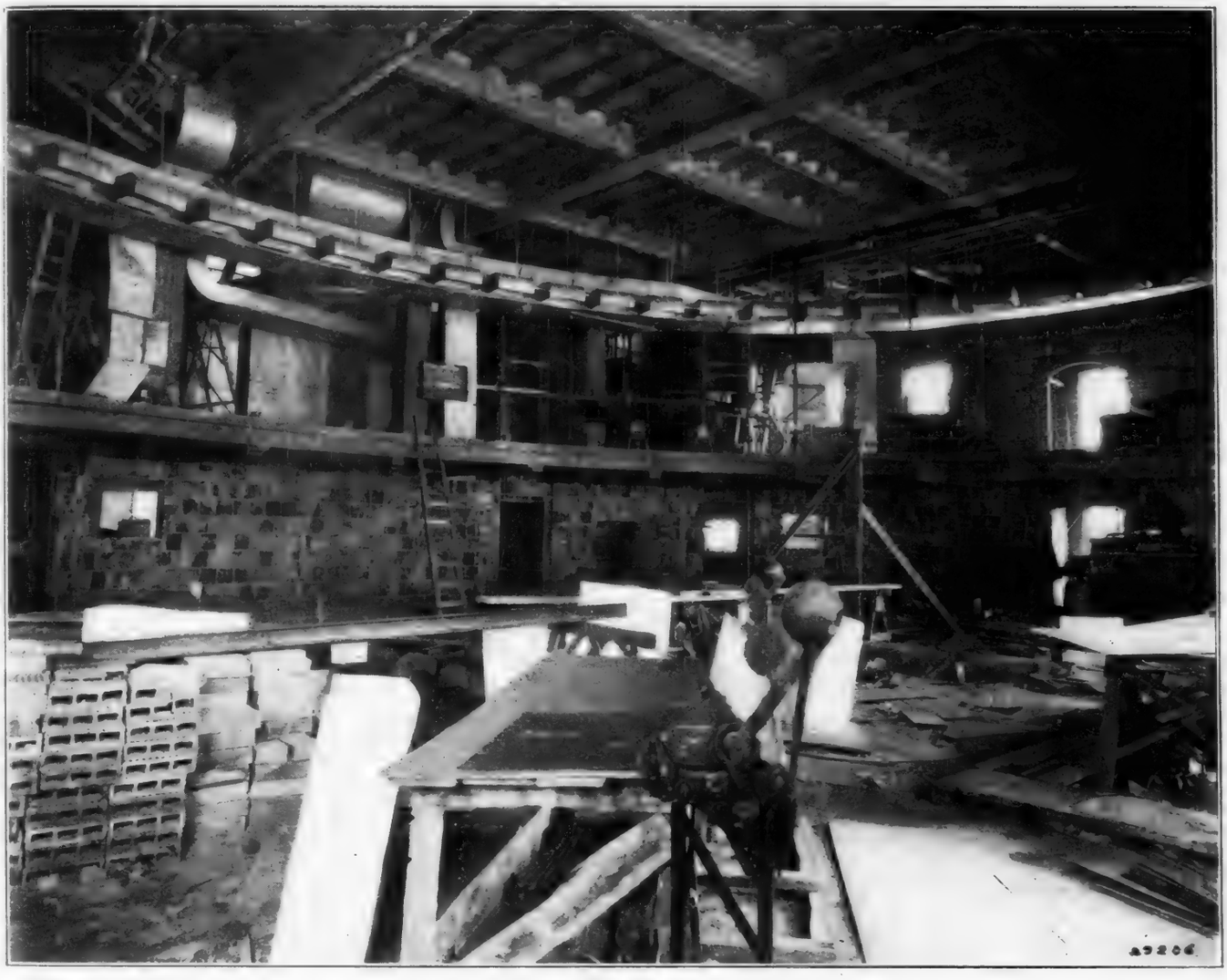
A Typical American Cyclone

The accompanying weather chart was made at the New York office of the United States Weather Bureau on the morning of March 29, 1924. It represents a typical American cyclone which was attended by many destructive tornadoes. This storm was by far the severest of the passing winter season in the Middle West.

Temperatures exceptionally high for the season prevailed in Missouri, southern Illinois, southern Indiana, western Kentucky, Tennessee, Alabama, Mississippi, Arkansas, and Oklahoma. Severe electrical storms and tornadoes occurred in all of these States. Thus relieved of its electrical energy and there being no anti-cyclone back of it, disintegration soon set in and on the following morning this storm bore little resemblance to the intense cyclone of the previous day.



The Tornado of March 29, 1924



Architects, O. B. Marienthal and W. W. Ahlschlager. Contracting engineers for heating and ventilating, Hanley & Co., Chicago.

Duct Work for the Ballroom and Mezzanine Floors of the Covenant Club of Chicago

Master Plumbers Adopt Plan for Scholarship in Sanitary Engineering

Prominent among the actions taken at the recent annual convention of the National Association of Master Plumbers, in West Baden, Ind., June 24-26, was the adoption of the plan submitted, for the Scholarship Committee, by Past President Frank J. Fee, for establishing a scholarship in sanitary engineering at New York University. A minimum sum of $3,000 was appropriated for the first year and will be deposited immediately as a trust fund. An equal amount will be set aside each year until the fund is large enough to insure the maintenance of the scholarship.

The estimated cost of the course is $1,000 per year, including tuition, room rent, books, meals and miscellaneous expenses. Half of this amount, or $500, will be paid by the National Association of Master Plumbers every year.

The plan is to choose one young man every year from among the sons of members of the master plumbers' association to take the course in sanitary engineering, with the aid of the association scholarship. In addition to his college work, the student will be required to work during the summer in a plumbing shop in his home town.

To show the scope of the course, a thorough grounding in chemistry and mathematics will be required, as well as the principles of engineering, to be followed, in the third and fourth years, by advanced study in mechanics, including heat engineering, and heating and ventilating engineering.

HOW THE ASSOCIATION IS MEETING THE APPRENTICESHIP PROBLEM

For the establishment of correspondence training schools for apprentices living distant from large towns, the sum of $5,625 was appropriated, to cover the cost of creating and maintaining a Correspondence Training Division.

A survey of labor conditions, contained in the report of the Apprenticeship committee, indicated that there are not more than 73,000 journeymen plumbers and 32,000 journeymen steam fitters in the country. The number of apprentices now in training was given as 5,000, while the estimated immediate needs are for not less than 12,500 apprentices.

So far 95 men have been enrolled in the Correspondence Teacher Training Course offered by the Apprenticeship Training Department, and it was stated that during the Spring of 1925 two or three intensive training courses will be given in leading educational institutions.

During the year eighteen apprenticeship schools were established, with a prospect of thirty more in the Fall.

Another forward step taken by the association was the adoption of a resolution to have a code of ethics prepared as a service and inspiration to members.

NEW OFFICERS

The new officers of the association are:

President, John J. Vogelpohl, Cincinnati, O.; vice-president, H. E. Longley, Wilmington, N. C.; secretary, E. B. Kleine, Cincinnati, O.; treasurer, Richard J. Welch, Lowell, Mass.

Among the committee appointments was one to take up with the boiler manufacturers the "establishment of stable, correct and dependable house-heating boiler capacities."

It was voted to hold the 1925 convention of the association in Portland, Oregon.

Summary of Effects Produced with Different Atmospheric Conditions

The Government Public Health Service has recently made an extensive investigation into the physiological effects of high temperatures and humidities with and without air movement. The summary of this investigation, as here presented, was compiled by a writer in *Factory* for May, 1924, for the benefit of factory managers in checking up conditions in their plants.

A. Remaining at rest in saturated air at 91½° F. for one hour, with no air movement, caused:

1. An increase in body temperature;
2. A moderate increase in pulse rate;
3. Profuse sweating;
4. After-effects of dizziness and weakness.

With air movement, caused:

1. Slight or no increase in body temperature;
2. Slight increase in pulse rate;
3. Slight perspiration;
4. No after-effects;
5. No ill effects at any time; but the noise of the fan was annoying.

B. Remaining at rest in saturated air at 95° F. for one hour, with no air movement, caused:

1. An increase in body temperature;
2. A marked increase in pulse rate;
3. Very profuse sweating, clothing being saturated with perspiration and sweat in shoes of all subjects;
4. Dizziness on movement, and increase in depth and rate of respiration (puffing somewhat on slight movement); chilly sensations in some subjects.

With air movement (250 to 600 lin. ft. per minute) caused:

1. Slight or no rise in body temperature;
2. Slight or no rise in pulse rate;
3. Profuse sweating, but not sufficient to wet all clothing;
4. No untoward symptoms in subjects, other than profuse sweating.

C. Remaining at rest in saturated air at 96° F., still and moving, caused the subjects to experience symptoms practically the same as those felt in still or moving saturated air, respectively, at 95° F.

D. Remaining at rest in saturated air at 98½° F. for one hour, with air movement, caused:

1. An increase in body temperature;
2. An increase in pulse rate (in one case to 183);
3. Very profuse sweating, clothing being saturated (sweat could be poured from shoes);
4. Dizziness on movement. All felt that little work could be done at this temperature and that the conditions were much worse than in moving saturated air at 95°, but not as bad as moving saturated air at 100° F.

E. Remaining at rest in saturated air at 100° F. with no air movement, caused:

1. A marked rise in body temperature, which reached 102.3° F.
2. A marked rise in pulse rate, varying in different subjects from 152 to more than 175;
3. Profuse sweating, the shoes being partly filled with perspiration;
4. Early appearance of dizziness, weakness, and persistence of symptoms for about one hour after test. The test was very trying.

With air movement (200 to 800 lin. ft. per minute) caused:

All the above symptoms, and no subject remained a full hour.

"The untoward effects upon man," concludes the author, P. K. Davis, "of almost saturated air with temperatures above 90° F. and below 98° F. are much less when the air is moving than when it is still. Further, the output or work that can be done is greater when the air is moving than when it is still, with the above temperature and humidity. No beneficial effects were found by moving saturated air at 98.6° or 100°, even at high velocities."

National Warm-Air Heating and Ventilating Association

Purpose and Scope of New Publicity Bureau

A flying start was made by the Warm-Air Heating Research Publicity Committee of The National Warm-Air Heating and Ventilating Association at its first meeting in Columbus, O., July 10 and 11, when the Publicity Bureau was established, with E. F. Glore as chairman, and a newspaper man of years of experience was appointed as director.

The committee has agreed on a number of fundamentals in the operation of the Bureau, some of which follow:

1. Using the Warm-Air Heating House now nearing completion by the members of the National Warm-Air Heating and Ventilating Association at Urbana, Ill., under the direction of the University of Illinois as the basis of facts to be presented to the industry and public, telling the truth about warm-air heating as proved by scientific tests under average livable conditions in the home.

2. Getting the experience of all those engaged in manufacturing and installing warm-air heating systems through written explanations of the best practice for proper and satisfactory methods of installation, maintenance and regulation of warm-air heating systems.

3. Editing and standardizing these articles into short, readable and understandable paragraphs which would be accepted and published by the press and other media as reading articles, which would tell the public that "warm-air heating is the best method of heating the home," and the reason why.

4. Asking the manufacturer and installer to promote the use of the Standard Code by explaining it and adhering to it wherever possible.

The Publicity Bureau is now ready to receive, edit and publish articles detailing experiences in installing satisfactory warm-air heating systems.

As a suggestion of what is meant, the following topics are presented as given in Bulletin 141 of the University of Illinois.

1. The proper location of furnace with respect to center of basement.
2. The proper location and number of re-circulating registers.
3. The proper location of warm-air outlet registers.
4. The relative value of inside and outside air.
5. The effect of various installation details on operation of basement pipes.
6. The effect of various installation details on operation of wall stacks to upper floors.
7. The significances and proper percentage relative humidity in the house.
8. The effect of wind.
9. Thermostatic control.

Doctor of Philosophy Degree for Professor F. E. Giesecke

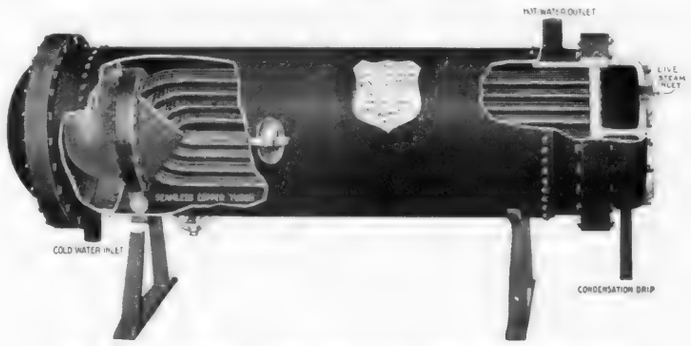
Based largely upon his thesis on "The Art of Heating Buildings by Gravity-Flow Hot-Water Heating Systems," the University of Illinois has conferred the degree of doctor of philosophy upon Professor F. E. Giesecke, professor of architectural engineering at the University of Texas. Professor Giesecke has been spending the past year at the University of Illinois studying for this degree, his studies embracing engineering, with special reference to heating and ventilation; hydraulics and architectural engineering.

Professor Giesecke's thesis covered the origin and development of gravity-flow water heating systems; experimental proof that during the state of steady operation of a gravity-flow water heating system the friction head in a radiator circuit is equal to the pressure head, due to the difference in density of the water in the corresponding flow and return risers; a study of experimental data showing the relation between the friction, pipe diameter, and the velocity, density and viscosity of the water when flow is taking place in commercial black or galvanized-iron pipe; a compilation of the data relating to the heat-dissipating coefficient of bare black pipe supplemented and extended by laboratory tests; and, finally, experimental determination of the heat-dissipation coefficient of a 3-col. 38 in. water radiator.

The committee in charge was composed of Professor A. C. Willard, chairman; and Professors A. N. Talbot, M. L. Enger, G. A. Goodenough and L. H. Provine.

New Trade Publications

OTIS STEAM-OPERATED WATER HEATERS, OTIS STORAGE-TANK HEATERS AND OTIS OPEN-TYPE FEED-WATER HEATERS AND PURIFIERS, comprising the line of the King Construction Co., successors to the Stewart Heater Co., North Tonawanda, N. Y., are presented in a series of circulars which give interesting details of each type. In the Otis steam-operated water heater, for instance, its construction of steel boiler plate is covered in detail, showing how the top plate is riveted to a heavy cast-iron ring with a projecting rim cast upon its outer surface forming a flange, also showing how the lower end of the shell is riveted to an inverted cone-shaped cast-iron bottom which is supported by four cast-iron legs, serving as a substantial base for the heater. The heating surface in all sizes of Otis heaters, it is pointed out, consists of 1¼-in. seamless drawn copper tubes, rolled into a tube sheet at the top and secured to a cast-iron water catcher at the bottom. This bank of tubes is free to move with expansion or contraction as it is secured only at the top or one end. There is a bend in each tube just above the water catcher, described as a distinctive Otis feature, which permits it to expand or contract independently of any other tube. In addition to illustrations of the various types, the catalogs contain full dimension tables and other needed information. The Otis storage-tank heaters are recommended for installation where the demands on a hot water supply are sudden and heavy and where the steam supply is inadequate to take care of these demands, such as laundries, hotels, apartments, institutions, dye houses, factories, etc. They are made in types for use with live steam, exhaust steam or for a combination of live and exhaust steam.



Otis Live Steam Instantaneous Feed-Water Heater. Horizontal Type

SIMS COMPANY PRODUCTS, including tubular feed-water heaters, open feed-water heaters, filters and purifiers; steam-tube storage heaters, gas-engine economizers with steam receivers, for making steam from waste heat; and the Simco low-pressure steam and water boilers, are featured in newly-issued circular matter received from the Sims Co., Erie, Pa.

MCCANN-HARRISON HEATER, DIRECT OIL-FIRED, for heating and ventilating buildings, is a recent product developed by the McCann-Harrison Corporation, Cleveland, O., and described in newly-issued circulars. The principle involved in these heaters is the direct transmission of heat from the fuel burned to the air passing through the heater. The heating surface consists of interlocked special-shaped tubes so arranged that the gases of combustion pass up vertically between and around the outside of the tubes, while the air being heated passes horizontally through the inside of the tubes. Maximum required air delivery temperatures, it is stated, are obtained with combustion gas temperatures not over 900° F. The company's long experience in metallurgical furnace work was drawn on in the design of the combustion chamber, while the burners used are also the result of many years' experience in the burning of fuel-oil. Atomization is obtained by the use of compressed air, obtained from a small air-compressor driven from the fan shaft. This jet of air is used to siphon the oil from a reservoir and to deliver it to the combustion chamber in the form of a mist. The burning is arranged to be proportional to the air pressure. Control, therefore, is maintained by varying the air pressure. Special precautions have been taken to prevent flooding and overheating. As the oil level in the reservoir is below the burner tips, oil can flow only when the air compressor and fan are running. The air compressor is operated by the fan so that it is impossible to light or operate the burners unless air is passing through the heater tubes. By setting a maximum air pressure, the amount of oil which can be burned is limited. Finally, the oil tips are made of large diameter to prevent clogging and to keep the flame from going out.

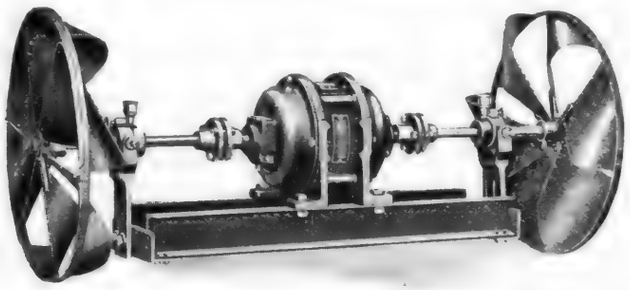
These heaters are built in standard sizes to suit various building requirements. The company reports a notable installation of four units in the sheet metal plant of the R. B. Hayward Company, Chicago. The air-distributing system is arranged for either recirculating all the air or taking in 100% outside air. A facsimile letter from the Hayward company is presented, expressing satisfaction over the system's operation. Figures are included which show a total minimum saving over a steam system of $1400.

McCann-Harrison Direct Oil-Fired Heater

TWINFAN SYSTEM OF HEATING, described as "improved heating for industrial buildings at minimum cost,"

Twinfan unit with case cut away to show Fan Mounting and Heating Coils

is the subject of a new booklet recently issued by the Dwyer Equipment Company, Chicago, Ill. The booklet covers the essential principles of good practice in industrial heating and offers detailed argument in favor of the Twinfan unit heaters. Numerous illustrations of actual Twinfan installations are included, together with drawings and charts describing the methods involved in the company's products. A complete Twinfan system, it is stated,



Motor and Fan Assembly of Twinfan Unit

consists of the boiler, necessary piping and appliances and the required number of Twinfan units. Each unit, when connected up, it is pointed out, is a complete heating machine. The unit is built of structural steel with sheet metal casing. Radiators, particularly designed for this type of work, are located in the bottom of the unit. An electric motor driving two fans is placed above the radiators. Steam is supplied to the heating coils in the usual way, the fans drawing cold air from the floor above the radiators and blowing the heated air out from the unit into the building.

RESIDENCE TANK HEATER, recently introduced by the National Pipe Bending Company, New Haven, Conn., is described in that company's bulletin No. 62. The new heater is attracting considerable interest in the trade. It

New Coal-Burning Residence Tank Heater

is a coal-burning tank heater, furnished in the smaller sizes for residence and apartment house use. Gray cast-iron is used in the top, base and grate while the case is of Armco iron. The combustion chamber above the grate is fire brick, lined, and in the hot gas zone is a double interwoven helical coil of heavy seamless brass tubes, cold drawn, the ends of which are brazed into bronze manifolds. These connect with the circulating piping to the storage tank. A rapid circulation of water across the heating surface, it is stated, is assured by the design of the coil.

RIC-WIL UNDERGROUND CONDUIT, for steam and hot water pipes, are described in the new 1924 catalogue of the Ric-Wil Co., Cleveland, O. This product is featured as a complete system of insulating conduit for underground steam and hot water pipes, condensation returns, fuel-oil, etc. It is made in four types. As will be noted from the accompanying illustrations, this conduit consists of a bell and spigot main tile, cast-iron pipe supports and a supporting interlocking base drain. The type shown in Fig. 1 is for use with high or low-pressure steam pipes, either single or in groups, and is especially designed for wet soil conditions.

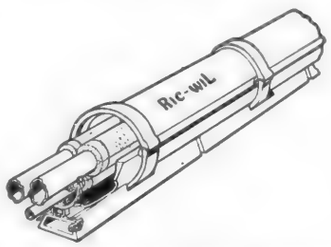


Fig. 1—Multiple-pipe, Support Blocks and Base Drain

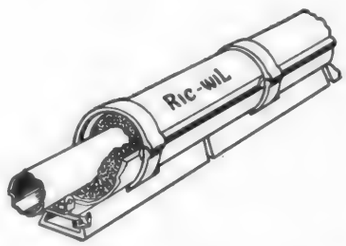


Fig. 2—Single-pipe, Base Drain

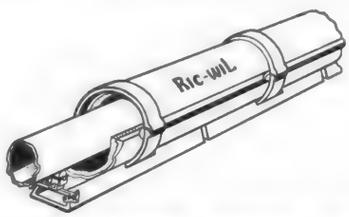


Fig. 3—Single-pipe, Support Blocks and Base Drain

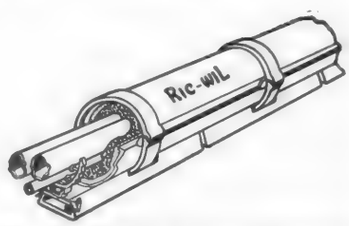


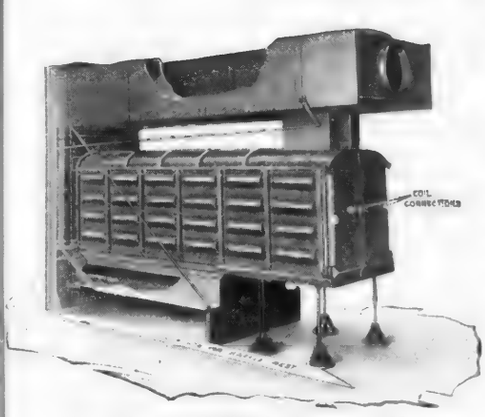
Fig. 4—Multiple-pipe Support Blocks and Base Drain

Types of Ric-Wil Underground Conduit

The insulation consists of sectional pipe covering applied directly to the pipes and of the air space between this covering and the inside of the tile. The type shown in Fig. 2 is for similar use, but the insulation is a conduit filler packed around the pipes. Fig. 3 shows a type for use in hot water work. Provision is made for oil pipes combined with a steam or hot water pipe to keep the oil warm. In this type the insulation is the company's well-known Sil-o-cel diatomaceous mixture. In the type shown in Fig. 4, which is designed for high or low-pressure steam heating and power pipes, the insulation is a conduit filler and a Sil-o-cel mixture. The catalogue contains a comprehensive description of each type, together with typical specifications and tables of pipe capacities for various sizes of conduit, and miscellaneous information connected with the figuring of underground heating work. Size 8 x 10¾ in. Pp. 16.

ELECTRIC HEATING APPARATUS, including the large electric boiler, manufactured by the Electric Furnace Construction Company, Philadelphia, Pa., are presented in a circular letter recently distributed by the company. Frank Hodson, president of the corporation, sets forth that the use of electricity for heat is growing phenomenally for the reason that it is both convenient and readily controlled.

XXTH CENTURY HORIZONTAL FURNACE, described as a powerful heater and ventilator especially designed for schools, churches and other buildings where the rooms are large, the occupants many, and especially where ventilation is required, is shown and described in a catalogue received from the XXth Century Heating and Ventilating Co., Akron, O. These heaters are of heavy cast-iron construction. The arrangement for the horizontal travel of air to be heated over the prime radiating surfaces of both the large combustion chamber and the radiator tubes, is featured as giving unusual economies. Another feature mentioned as resulting from this arrangement is the delivery of the heated air to the warm-air chamber mixed and at one temperature, resulting in the same temperature of the air delivered to all parts of the building. Care is taken to insure free circulation of air on the back side of the fire-box linings to prevent overheating at this point in the furnace. Provi-



Rear View of XXth Century Horizontal Flow Furnace

sion is made for expansion of the combustion chamber and radiator section, such expansion taking place towards the rear. Among the special conveniences mentioned for this heater are the different arrangements of draft dampers and by-pass dampers by which a more direct draft may be secured, when desired, or the combustion checked. Views are shown of a single heater and of the heater arranged in batteries. Size 7 x 10¼ in.

WEBSTER VACUUM SYSTEM OF STEAM HEATING and an imposing array of installations of this system are featured in a booklet recently issued by Warren Webster & Co., Camden, N. J. Starting with the Equitable Building, in New York, and extending across the country, the booklet contains views of some 23 important structures which are Webster-equipped, the booklet concluding with a note on the Webster organization which has been developed during the company's 25 years of existence for rendering service to architects, engineers, contractors and owners.

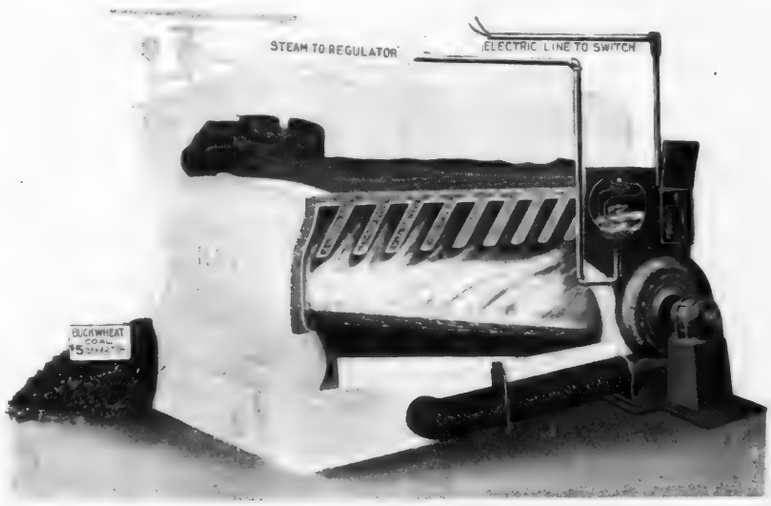
STICKLE STEAM SPECIALTIES, covering the Stickle line of steam traps, vacuum heating specialties, feed-water heaters, oil and steam separators, damper regulators, reducing valves, and paper and textile mill supplies, are presented in a new comprehensive catalogue published by the Stickle Steam Specialties Co., Indianapolis, Ind. First place is given in the catalogue to the various types of steam traps made by the company to meet varied conditions. Particular interest attaches to the Stickle pop-valve trap designed for service where large volumes of water are handled in either high or low pressure. The distinctive feature of this type is that no change of valve is necessary for service from 5 to 150 lbs. pressure. In the vacuum heating section, special attention is directed to the Stickle Thermic radiator valve, the Stickle Thermic vacuum valve, the Stickle vacuum radiator valve and the Stickle thermostatic radiator valve. In each section of the catalogue many useful notes and data are given covering such points as good steam trap practice, how to determine the size of a steam trap, how to obtain a proper circulation of steam in a heating system and how to drain blast coils or indirect radiators. All of the devices listed in the catalogue are fully described and illustrated. Size 6 x 9 in. Pp. 256.

REED AIR FILTER COMPANY, INC., Louisville, Ky., has issued an attractive folder to fit the average letter file in which a complete file of the company's bulletins may be retained permanently. The company deals in air purification and dust elimination equipment. Various bulletins issued from time to time describe the Reed systems of air filtration, some covering the field generally and others being devoted to filters for particular uses, such as general ventilation, electrical ventilation, filters for air compressors and for drying operations and bacteria control. Each bulletin is illustrated with drawings and installation photographs. Another feature of this company's bulletin service is a series on standard specifications for air filters in general ventilation.

DIAGRAMS AND INSTRUCTIONS FOR INSTALLING THRUSH EQUIPMENT are furnished the trade in a useful circular issued by H. A. Thrush & Co., Peru, Ind. In a series of thirteen illustrations the circular shows in detail how the Thrush water-temperature damper regulator operates and how the Thrush pressure-relief and Thrush pressure tank are used to control the pressure of the water in the heating system, to increase the radiation and to prevent "easy boiling," as well as to provide a safe overflow. The illustrations show how the pressure tank is installed in the basement, so as to avoid any danger of freezing or the tearing up of floors or walls, if the installation is made in an old building. In the illustrations comprising the circular a square boiler is shown with two pressure tanks and the Thrush equipment is presented as applied to an overhead piping system, as well as for a low basement and for various other conditions. The company has recently inaugurated the publication of a monthly periodical, the *Thrush Regulator*, which, we understand, will be sent regularly upon request to those desiring it.

TYCOS RECORDING THERMOMETERS, for use in regulating temperatures in churches, are featured in a story sent out by the Taylor Instrument Companies, Rochester, N. Y., describing an installation in the First Methodist Church of Hamilton, Ontario. The bulb is placed in front of the pulpit and the instrument down in the boiler room, where the engineer keeps a complete record of the temperature and thereby controls the heat.

THE WARREN STANDARD is the name of a new house publication recently issued by the S. D. Warren Company, Boston, Mass., in which, it is announced, will be published from time to time discussions of various paper and printing problems. The initial issue of this publication is given over the "wet and dry question" as it affects the paper and printing industry. Both excessive and insufficient humidities are the causes of many press-room and bindery troubles it is pointed out. The magazine describes many of the methods in use at the Warren company plants to obtain proper temperatures, humidity and ventilation.



Yarwood Economy Coal Burner in Operation

New Publications

PRINCIPLES OF DAIRY-BARN VENTILATION, together with a discussion of the systems of barn ventilation in common use, is the subject of Farmer's Bulletin No. 1393, issued by the U. S. Department of Agriculture. The illustrations include diagrams of the King system, the Rutherford system and a modified King system, together with methods of window ventilation, different styles of wood cupola, and examples of good flue installations. As the bulletin states, it is becoming to be generally recognized now that ventilation in barns and other buildings in which stock are kept is just as necessary, as a health measure, as in homes, schools, factories and other buildings in which human beings live

or work in more or less close quarters. With the demand for a greater winter production of milk, has come the demand for tightly-built shelter for the cows, particularly in the colder sections of the country. But tightly-constructed barns are apt to be damp unless ventilation is provided, and the stabling of animals in dark, poorly ventilated, damp barns affects their health. The bulletin is published under the authorship of M. A. R. Kelley, agricultural engineer, Division of Agricultural Engineering, Bureau of Public Roads. Size 6x9 in. Pp. 22.

New Books

PRACTICAL MATHEMATICAL ANALYSIS, by H. Von Sanden, professor of mathematics at the University of Clausthal, and translated by Professor H. Levy, professor of mathematics at the Imperial College of Science and Technology, London, is described as bridging the gap between the elegant solutions of pure mathematics and the practical numerical solutions required by physicists and engineers. The work is based upon the courses in numerical and graphical calculation conducted at the University of Göttingen by Professor C. Runge. It will be found especially useful to those engaged in technical work of a difficult character and particularly in research. One of the interesting sections is devoted to "Principles and Tricks of the Slide Rule," in which its fundamental principles are set forth and some interesting "tricks" explained, such as dividing the same number in succession by each of a whole series of different numbers, and solving cubic equations. Size 6x9. Pp. xv-195. Cloth $4.50. Published by E. P. Dutton & Co., 681 Fifth Avenue, New York.

The Meanest Man on Earth

The library receives over 200 current periodicals and society publications. These form the best source for the up-to-the-minute information desired by our members. Manifestly, our reference work is crippled when the unbound numbers disappear. This is also the case when current issues are taken from the rack and returned a few days later.

Here is a list of missing periodicals which will never be returned now. Can you help us replace them? Engineering Education, August, 1923; Bus Transportation, June, 1922; American Waterworks Association Journal, June, 1923; Heating and Ventilating Magazine, November and December, 1923; A. S. C. E. Proceedings, March, 1924; Radio News, May, 1924.

We fully believe that the villain who steals magazines from the reading room is the meanest man on earth.—*From the Journal of the Western Society of Engineers for June, 1924.*

While we do not desire to countenance, in any respect, the practice of which the *Journal* of the Western Society of Engineers complains, we cannot overlook the compliment unwittingly paid to a technical journal when a would-be reader is willing to beg, borrow or steal a copy to supply his needs. We are happy to state that we have been able to replace the two missing copies of THE HEATING AND VENTILATING MAGAZINE which were so highly prized by our unknown reader. —EDITOR.

Benjamin G. Lamme

The death on July 8 of Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, removed one of the world's leading electrical authorities. Mr. Lamme had been ill for several months at the home of his sisters, 230 Stratford Street, East Liberty, Pa.

Mr. Lamme was credited with many accomplishments in his chosen field, one of which was the perfecting of railway and industrial motors and synchronous converters whereby alternating current was made useful at any point.

He was born on a farm near Springfield, O., January 12, 1864. After graduating from Ohio State University, he entered the employment of the westinghouse company in 1889 at the salary of $30 a month. His most spectacular work was in connection with the power development of Niagara Falls.

Charles A. Geoghegan

CHARLES A. GEOGHEGAN, president of Gillis & Geoghegan, heating and ventilating contractor, New York City, and long prominent in the industry, died from septic poisoning recently at his home in New York. His many friends in the trade and elsewhere were greatly shocked at his passing. Few of them had known of his illness and his death therefore came as a painful surprise.

Mr. Geoghegan was one of the best known heating contractors in the country, and was a past president of the National Heating and Piping Contractors' Association.

Deaths

JOHN A. MURRAY, SR., president of John A. Murray & Sons, heating and plumbing jobbers, 312 West 39th Street, New York, long identified with the heating and plumbing supply business, died July 7. Death was caused by heart failure after an operation.

Mr. Murray founded the house he headed in 1898 as the John A. Murray Co., incorporating it under its present name January 1, 1921. His widow and two sons, John A. Murray, Jr., and Joseph N. Murray, survive.

RILEY LOUIS REDPATH, general manager of manufacturing of the American Radiator Company, died suddenly in Buffalo, N. Y., June 17. Mr. Redpath occupied a notable position in the business life of Buffalo, just as he had previously held commanding positions in the industrial activities of St. Louis, Detroit and Kansas City. For 25 years he had been at the head of various manufacturing interests of the American Radiator Company and for six years previous to that with the former St. Louis Radiator Company, of St. Louis.

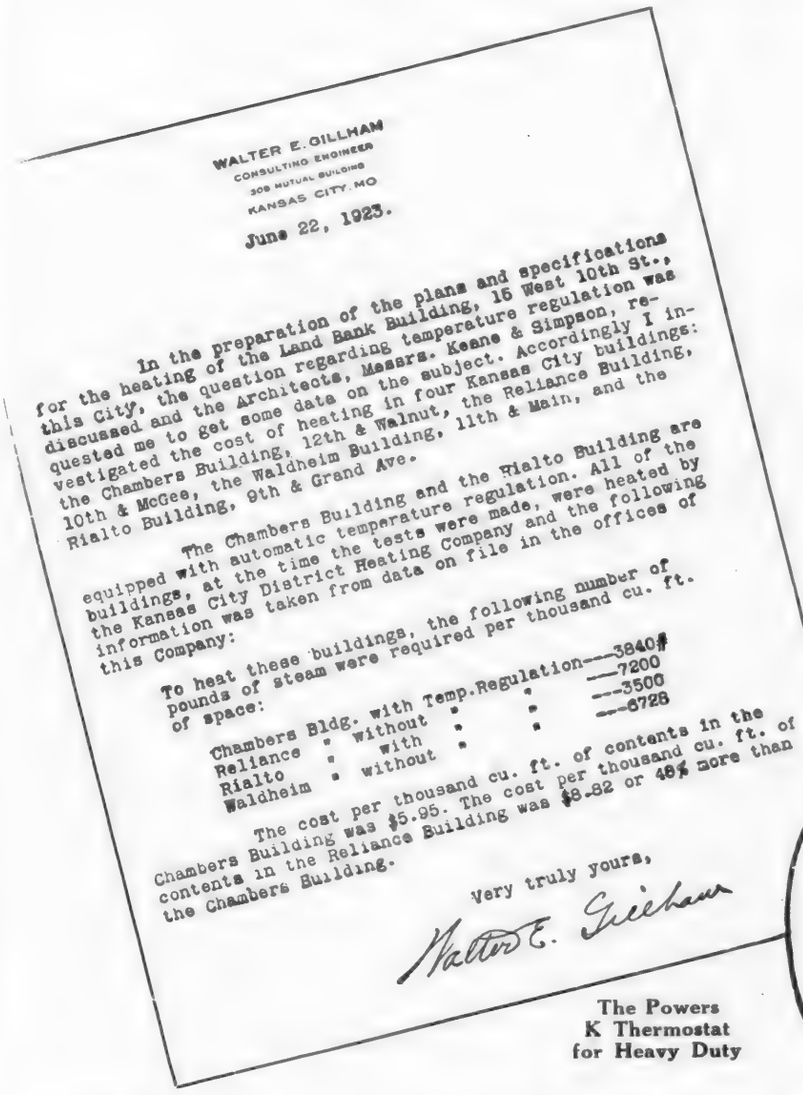
Mr. Redpath was born in Baldwin, Ill., in 1871. During the World War he distinguished himself as a member of the United States Fuel Conservation Commission and the United States Labor Board. During his five years' residence in Buffalo, he was a member of the Chamber of Commerce, being especially active in the work of the National Safety Council Division.

On the day of his funeral services in

The Late Riley L. Redpath

Buffalo, the plants of the company were closed, while 6000 employees in that city paid tribute to the memory of their friend and chief. Officials of the company, members of its board of directors, managers of plants and sales branches, attended the services. The honorary pall bearers were: C. M. Woolley, C. M. Parker, C. K. Foster, R. B. Flershem, H. J. Rente, M. J. Beirn, J. H. Sproat, J. M. Edeall, R. H. Mann, F. B. Howell, J. F. Groebe and S. B. DeLong.

R. D. HOPKINS, heating and ventilating engineer, formerly of New York, and for the past ten years or more located in Peking, China, died in Peking, June 17 of paralysis. He was 50 years old. Mr. Hopkins was formerly connected with Rossman & Bracken, of New York. One of his most important assignments previous to going to China was that of superintendent of construction of the Biltmore Estate, in Biltmore, S. C. His initial visit to China was for the purpose of superintending the installation of the mechanical equipment for the buildings of the Chinese Bureau of Engraving and Printing. After that work was finished he returned to the United States, going back to the Orient a year later where he joined the Etablissements Arnoult, in Peking. Mr. Hopkins was 50 years old. He leaves a widow, one son, just graduated from Cornell University, and one daughter



WALTER E. GILLHAM
CONSULTING ENGINEER
309 MUTUAL BUILDING
KANSAS CITY, MO

June 22, 1923.

In the preparation of the plans and specifications for the heating of the Land Bank Building, 16 West 10th St., this City, the question regarding temperature regulation was discussed and the Architects, Messrs. Keene & Simpson, requested me to get some data on the subject. Accordingly I investigated the cost of heating in four Kansas City buildings: the Chambers Building, 12th & Walnut, the Reliance Building, 10th & McGee, the Waldheim Building, 11th & Main, and the Rialto Building, 9th & Grand Ave.

The Chambers Building and the Rialto Building are equipped with automatic temperature regulation. All of the buildings, at the time the tests were made, were heated by the Kansas City District Heating Company and the following information was taken from data on file in the offices of this Company:

To heat these buildings, the following number of pounds of steam were required per thousand cu. ft. of space:

Chambers Bldg. with Temp.Regulation		3840#
Reliance " Without " "		7200
Rialto " with " "		3500
Waldheim " without " "		6728

The cost per thousand cu. ft. of contents in the Chambers Building was $5.95. The cost per thousand cu. ft. of contents in the Reliance Building was $8.82 or 48% more than the Chambers Building.

Very truly yours,

Walter E. Gillham

The Powers
K Thermostat
for Heavy Duty

This Test Shows

48 per cent

Saving of Steam

with POWERS temperature control

Partial List of Users

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American Woolen Co.
E. I. DuPont de Nemours Co.
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Phoenix Mutual Life Ins. Co.
Rothacker Film Co.
B. & O. Railway
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Does automatic temperature control in Workrooms, Offices, Schools, etc., really pay?

The proof shown in the above test is typical of many others which have shown remarkable savings of fuel with Powers automatic temperature control.

Tests show that the majority of workrooms are overheated. Eliminate overheating with Powers temperature control, and you improve the health and increase the output of workers. The effect overheating has on the output of men is shown in the report of the New York State Commission on Ventilation, which says:

"An increase of room temperature from 68° F. to 75° F. caused a decrease of 15 per cent in the physical work performed by men who were not compelled to maximum effort but were stimulated by a cash bonus."

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Our book, "THE ELIMINATION OF HEAT WASTE," shows how and why a Powers System of Temperature Control gives such remarkably long and accurate service, and why its high first cost is cheapest in the end. May we send you a copy?

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33 years of specialization in automatic temperature control

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Baltimore	Cincinnati	El Paso	Milwaukee	Philadelphia	CANADIAN OFFICES	
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2450-A

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

VAPOR HEATING

Webster Type R Modulation System

(Continued from Data Sheet No. 132-J, revised)

Fig. 4 is a cross section of the Sylphon thermostatic trap. The expansion member consists of a Sylphon bellows, carrying a conical-shaped valve piece, closing against a sharp-edged seat. The bellows member is very sensitive, opening to pass condensate and air, but closing to prevent passage of the steam.

Another slightly less expensive trap which is sometimes used by the same organization is known as the No. 7 trap (Fig. 5). It is of the multi-diaphragm type, built of four successive phosphor bronze plates and its operation is similar in principle to other diaphram types already described.

Vent Valve

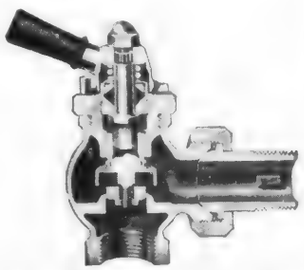

Fig. 3—Webster Modulation Valve

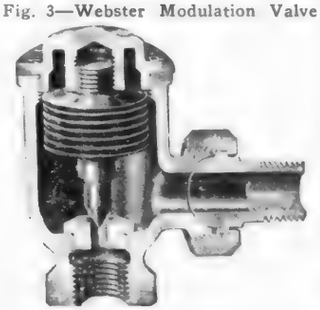

Fig. 4—Webster Sylphon Trap

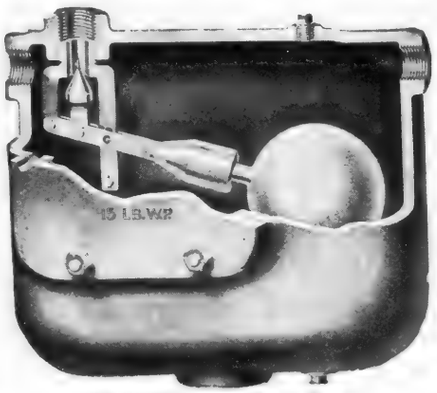

Fig. 6—Webster Vent Trap

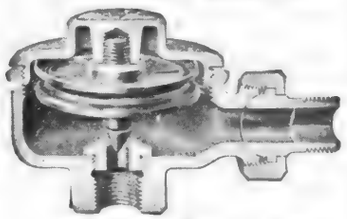

Fig. 5—Webster No. 7 Trap

Size Boiler-return Trap	Rating sq. ft. Direct Radiation	Dimensions	Tappings			No. of ½-in. Vent Valves	Size of Vent Trap	Tappings		
		H	O	S	E			R	U	V
0023	1500	14¼	1½	¾	½	1	0023	1	1	½
023	2500	16¾	2	1¼	½	1	023	1	2	½
123	4000	18¾	2½	1¼	½	1	123	1¼	2½	1¼
223	8000	23	3 flg.	1½	¾	2	223	1¼	3 flg.	1¼
323	16000	26¾	3½ flg.	1½	¾	3	323	1¼	3½ flg.	1¼

All dimensions in inches

Table for Sizing Connections Around a Webster Boiler Return Trap

(Concluded on Data Sheet No. 132-J2)

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

VAPOR HEATING

Webster Type R Modulation System

(Concluded from Data Sheet No. 132-J1)

A cross section of the vent trap is shown in Fig. 6 and the boiler return trap is shown in Fig. 7.

The last important item in this system is the sensitive, low pressure damper regulator, which is designed to maintain the desired boiler pressure within a very few ounces of that for which it is set. As can be seen in the cross sectional view, Fig. 8, it consists of a lower chamber partially filled with water. From the bottom

Fig. 7—Webster Boiler Return Trap

of this chamber a small pipe is carried up and connected to the space below the diaphragm, so that any pressure exerted on the surface of the water in the lower chamber will result in drawing the water out through the pipe and into the upper chamber where it exerts an upward pressure on the diaphragm, causing a movement of the lever arm which, in turn, operates the dampers. A steam pipe from the boiler is connected into the lower chamber just above the water level.

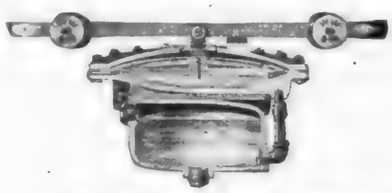

Fig. 8—Webster Damper Regulator

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

VAPOR HEATING

The Dunham System

In the Dunham system, as developed by the C. A. Dunham Co., Chicago, Ill., the piping is arranged as shown in Fig. 1, illustrating the method of running the piping in heating of residences.

This is a closed return system, with each radiator having a trap designed to prevent the steam from entering the return line, and, in that way, to accomplish a saving of fuel and elimination of pounding in the pipes and radiation.

The steam passes from the boiler into the steam main in the usual manner and up to the radiators, into which it flows through the Dunham packless inlet valve, (Fig. 2).

This valve utilizes a series of diaphragms for allowing the free up-and-down movement of the spindle without steam leakage. The construction of the Dunham valve permits it to be partially opened and closed at will, also restricting the flow of steam to the radiator the same as for other valves of graduated type.

This valve can be used on any two-pipe steam heating system, either vapor, vacuum or pressure. It is made in various patterns, lever-handle type and wheel-handle type.

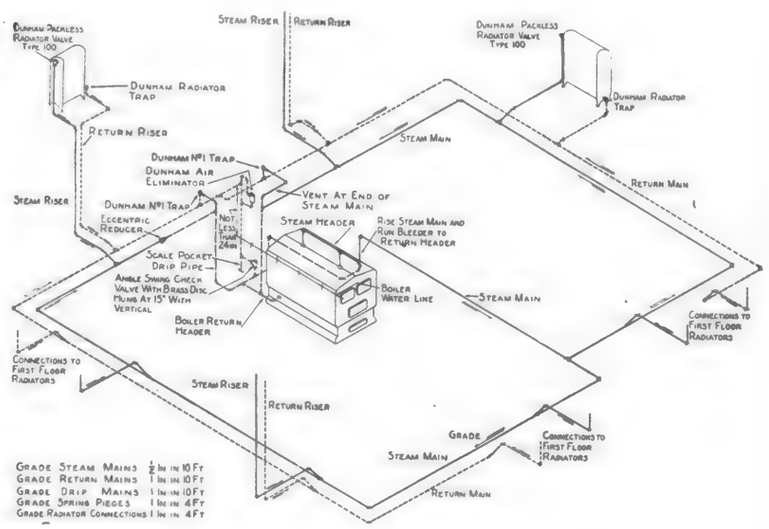
Dunham Packless Radiator Valve Type 100
Steam Riser
Return Riser
Dunham Radiator Trap
Return Riser
Dunham No1 Trap
Dunham Air Eliminator
Steam Riser
Dunham No1 Trap
Eccentric Reducer
Not Less Than 24in.
Scale Pocket Drip Pipe
Angle Swing Check Valve With Brass Disc Hung At 15° With Vertical
Boiler Return Header
Vent At End Of Steam Main
Steam Header
Rise Steam Main And Run Bleeder To Return Header
Boiler Water Line
Steam Main
Dunham Packless Radiator Valve Type 100
Dunham Radiator Trap
Steam Main
Return Main
Connections To First Floor Radiators
Connections To First Floor Radiators
Steam Riser
Return Riser
Grade
Steam Main
Connections To First Floor Radiators
Return Main
Grade Steam Mains ¼ In in 10 Ft
Grade Return Mains 1 In in 10 Ft
Grade Drip Mains 1 In in 10 Ft
Grade Spring Pieces 1 In in 4 Ft
Grade Radiator Connections 1 In in 4 Ft

Fig. 1—Typical Layout of Dunham System

The following schedule of tappings for direct cast-iron radiators is recommended for all two-pipe Dunham heating systems.

Table E—Water-Type Radiation

Square Feet	Inlet at Top, Inches	Outlet at Bottom, Inches
Up to 25	½	½
26–100	¾	½
101–180	1	¾
181–300	1¼	1

Table F—Steam Type Radiation

Square Feet	Inlet at Bottom, Inches	Outlet at Bottom, Inches
Up to 25	½	½
26– 80	¾	½
81–150	1	¾
151–300	1¼	¾
301–450	1½	½*

* ¾ over 350 sq. ft.

(Concluded on Data Sheet No. 132-L)

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

VAPOR HEATING

The Dunham System

(Concluded from Data Sheet No. 132-K)

After passing through the radiator the air and condensation escape through the Dunham radiator trap (Fig. 3).

When the radiator has filled with steam and the steam surrounds the thermostatic disc in the trap, the volatile fluids within the disc are heated and vaporized, thereby creating a pressure within the disc. This internal pressure expands the disc, the valve seats over the opening, and waste of steam is prevented. Subsequent water and air forming in the radiator fall to the bottom, surround the disc, condense the gasses within it, and the disc contracts, raising the valve from its seat and allowing the air and water to pass out into the return line. Steam, following behind the air and water, causes the disc to again close. The trap soon adjusts itself to a position corresponding to the water temperature, just as a thermometer does to the room temperature and permits a continuous flow of water from the radiator.

The Dunham radiator trap is for use on all two-pipe steam systems, using steam below atmospheric pressure, as in the case of a vacuum system, or up to 10 lbs. pressure above atmosphere. It can be applied on either steam or water-type radiators. The use of water-type radiators is recommended, however, as circulation through the radiator takes place more quickly and at a lower steam pressure.

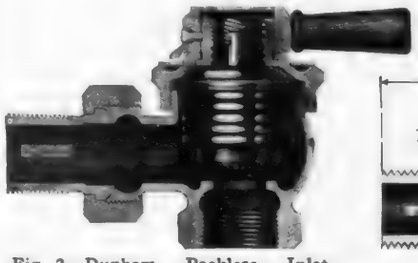

Fig. 2—Dunham Packless Inlet Valve

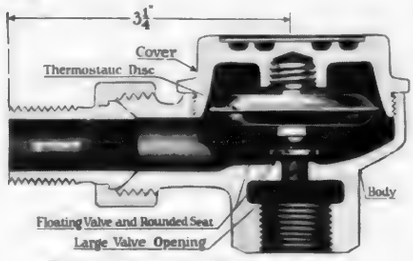

Fig. 3—Dunham Radiator Trap

The traps conform with the standard dimension of 3¼ in. from center of trap to end of union nipple, as adopted by the Heating and Piping Contractors' National Association for ½-in. radiator traps.

The steam main pitches down to the point where the last radiator connection is taken off. Here an air vent is located to relieve the air, the pipe being run to a Dunham No. 1 trap, which permits the air to escape into the return line, while the condensation flowing along the main is relieved by a drip at the end of the main which drops down under the water-line and is connected to the boiler.

The return main runs parallel with the steam main, thus obtaining even distribution of heat, and pitches down in the same direction. At the end of the run the condensation passes a check valve while the air is relieved to atmosphere through the Dunham air eliminator. The low level of the return main must be kept at least 24 in. above the boiler water-line, so as to permit the air eliminator to function properly.

The Dunham air check, when used with the air eliminator, acts to prevent the air from flowing back into the piping and radiators, with the result that a partial vacuum forms in the system, allowing the water in the boiler to be boiling at temperatures below 212° F.

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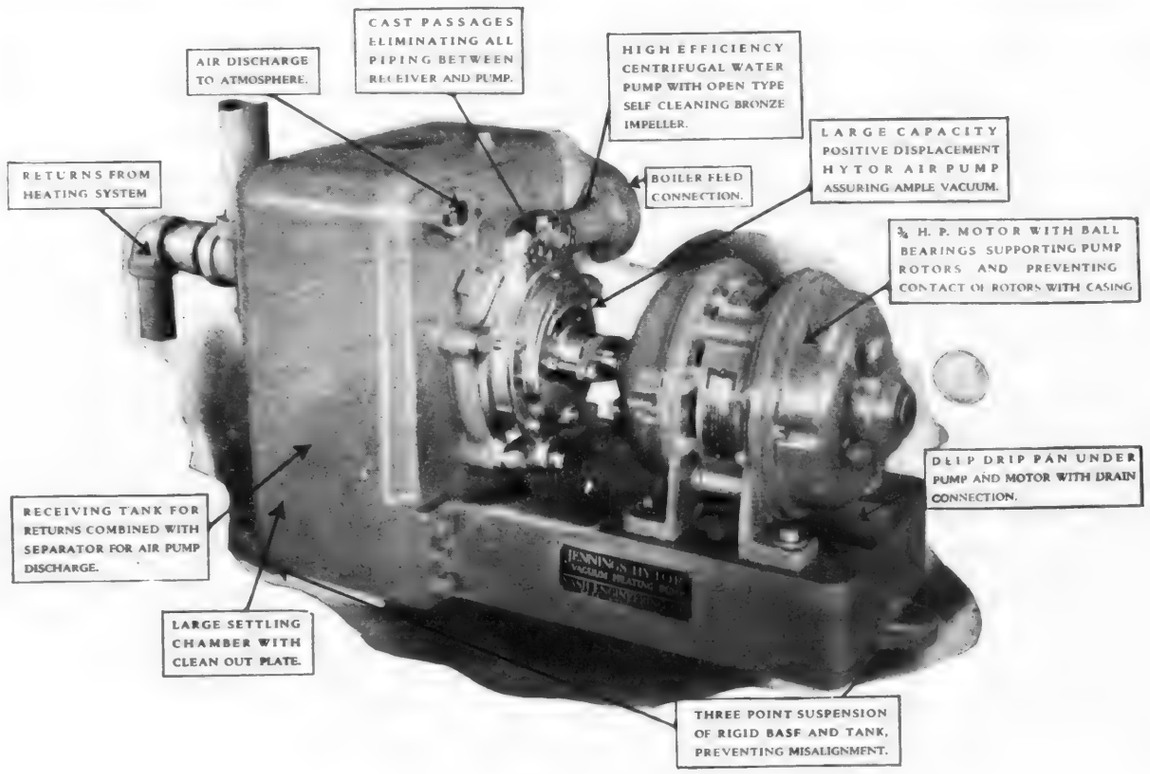
AIR DISCHARGE TO ATMOSPHERE.
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HIGH EFFICIENCY CENTRIFUGAL WATER PUMP WITH OPEN TYPE SELF CLEANING BRONZE IMPELLER.
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RETURNS FROM HEATING SYSTEM
BOILER FEED CONNECTION.
¾ H. P. MOTOR WITH BALL BEARINGS SUPPORTING PUMP ROTORS AND PREVENTING CONTACT OF ROTORS WITH CASING
DEEP DRIP PAN UNDER PUMP AND MOTOR WITH DRAIN CONNECTION.
RECEIVING TANK FOR RETURNS COMBINED WITH SEPARATOR FOR AIR PUMP DISCHARGE.
LARGE SETTLING CHAMBER WITH CLEAN OUT PLATE.
THREE POINT SUSPENSION OF RIGID BASE AND TANK, PREVENTING MISALIGNMENT.

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Aug. 1924

Trade and Miscellaneous Notes

Miscellaneous Notes

Building Operations held up at a remarkable rate in June, declining only about 8% from May and recording a 5% increase over June, 1923, according to the F. W. Dodge Corporation. Contracts awarded in June in 36 eastern States, comprising about seven-eighths of the total construction volume of the country, aggregated $387,521,100. Construction started in these 36 States for the first six months of the year amounted to $2,323,816,900, a record figure, being 10% greater than for the corresponding period last year. June building contracts in New York State and northern New Jersey decreased 17% over the previous month. However, the increase for the first six months in this district was 56% above that of the same period a year ago.

American Institute of the City of New York announces an exposition of inventions to be held in the Engineering Societies Building, New York, December 8 to 13, 1924, inclusive. Working models of inventions in various industries, including heating and ventilating, will be displayed during the exposition. All proposed displays will be subject to approval by the Institute as it is desired to show only those things of sound worth.

American Association of Oil Burner Manufacturers held the quarterly meeting of its directors at the Congress Hotel, Chicago, Ill., July 8, 1924. Edward P. Bailey, president of the National Airoil Burner Co., Philadelphia, presided. Chicago was selected as the place for the next annual meeting, to be held in April, 1925.

Builders' Code, adopted by members of the Associated Building Contractors of Illinois at a district convention in Pekin, Ill., May 27, 1924, has been printed and circularized among the State's builders. The code, somewhat similar to that of the Chamber of Commerce of the United States, calls upon all builders to live according to the "Golden Rule."

National Association of Master Plumbers has moved its headquarters from Newark, N. J., the residence of former President Samuel F. Wilson, to Cincinnati, O., the home city of the new president, John J. Vogelpohl. Headquarters are at 4125 Hamilton Avenue, Cincinnati.

Chicago, Ill.—Work has been started on an elaborate recreation building for Regas Brothers and Peter Danigeles to be known as Pioneer Arcade. A mechanical ventilating system is one of the features of the plans drawn by Architect Jens J. Jensen.

American Association of Oil Burner Manufacturers, acting at the request of the Western Petroleum Refiners' Association, has named a committee to conduct a series of tests on domestic oil burners at the experiment station of the Bureau of Mines at Bartlesville, Okla. Following are the members of the committee: P. S. Russell, Home Appliance Corp., St. Louis, Mo., chairman; A. N. Eaton, Winslow Boiler & Engineering Co., Chicago; and C. B. Finnell, Oliver Oil Gas Burner Co., St. Louis, Mo.

Better Trade Relations was the subject of an address delivered recently at the Chicago meeting of the National Retail Dry Goods Association by Alvin E. Dodd, manager of the department of Domestic Distribution of the Chamber of Commerce of the United States. Mr. Dodd advocated closer co-operation between manufacturers, wholesalers and retailers in establishing ethical standards of business practice.

Better Homes in America has issued

FOR SUMMER VENTILATING JOBS

Illustrating Accessibility to Brushes and Inspection of Direct Current Motor

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a booklet on "How to Furnish the Small Home" treating in detail the complete furnishings for a three-room house, a five and a seven-room house. It is sold on application to the headquarters 1653 Pennsylvania Avenue, Washington, D. C., for 25 cents, the cost of the publication.

National Safety Council, 168 North Michigan Avenue, Chicago, Ill., has issued pamphlet No. 61, entitled "Mechanical Refrigeration," describing the dangers of such equipment and the methods of lessening that hazard.

Chamber of Commerce of the United States has issued a revised edition of a pamphlet on retailers' expenses. The first edition attained a distribution of 60,000 copies. The book points out the gross margin common in the various trades, thus permitting the retailer to better adjust his expenses and profits.

Percy Nicholls, who has been associated for the past year with the Research Laboratory of the American Society of Heating and Ventilating Engineers, has joined the staff of the Fuel Section of the Bureau of Mines.

James A. Donnelly, treasurer of the Donnelly Systems Co., New York, has the sympathy of his many friends in the death of his wife in New Haven, Conn., recently. Mrs. Donnelly had long been ill.

D. M. Nesbit, for many years treasurer of the National Association of Master Heating and Domestic Engineers, with headquarters in London, England, and who is known to many American heating engineers and contractors, was the recipient of a silver salver, in recognition of his services, at a dinner in London, commemorating the twenty-first anniversary of the founding of the association. The presentation was made by the Lord Mayor of London who spoke of the fact that Mr. Nesbit was largely instrumental in organizing the association, which has a status in England similar to that of the heating contractors' association in the United States. Mr. Nesbit was the first president of the association and has been its treasurer ever since.

Manufacturers' Notes

Heat Equipment Corporation, Lincoln, Neb., announces the following election of new officers: F. Pace Woods, formerly general manager, president and W. H. Johnson, secretary. L. W. Kline was re-appointed sales manager. H. L. Decker, of the American Society of Mechanical Engineers, has become associated with the company for the purpose of making tests of the company's oil heating products.

Johnson Fan & Blower Co., Chicago, Ill., has removed to its new address at 169 North May Street, Chicago.

American Radiator Co., New York, announces the appointment of Homer R. Linn, for some years engineer of the Chicago branch, as engineer of the western executive department of the company. Mr. Linn will continue to maintain headquarters in the American Radiator Co., building, 820 South Michigan Avenue, Chicago.

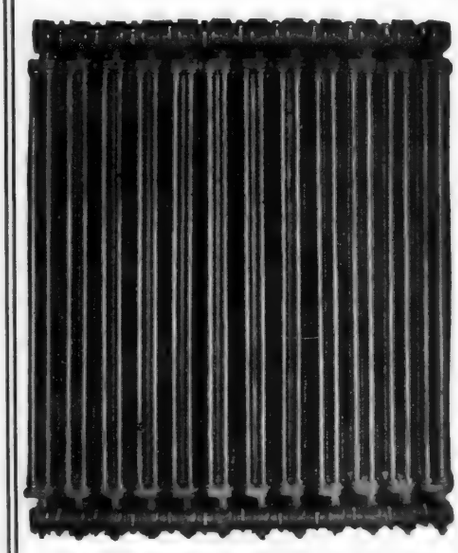
Atmospheric Conditioning Corporation, Philadelphia, Pa., has moved its New York offices from room 619 to room 623 Singer Building.

Advance Boiler Company, New York, whose president, Henry Lipkemann died recently, has reorganized with new officers and increased capitalization. Henry Dunkak is the new president. Other officers are: Joseph Paterno, vice-president; Charles Hensle, treasurer, and William Dunkak, secretary. Plans are under way for extensive improvements at the company's Poughkeepsie, N. Y., plant.

A. H. Wolff Gas Radiator Co., New York, announces the appointment of H. Leigh Whitelaw as general manager. Mr. Whitelaw, who was connected with the American Radiator Co., for fourteen years and has been closely associated with the development and sale of gas-fired boilers and gas-fired steam radiators since the World War, when he served with the British Royal Air Force, joined the Wolff Company last fall as manager of the boiler department.

National Airoil Burner Co., Philadelphia, Pa., has increased its stock from $75,000 to $1,000,000 to provide for increased production. John F. Straitz is president of the company and Edward B. Bailey, president of the American Association Oil Burner Manufacturers, is treasurer. Other officers are: R. B.

Hot Blast Heating Perfected by the Lyon Interlocking Heaters



Their many superior features recommend them to the heating expert

The Lyon Interlocking Heaters are built in small sections of eight one inch pipes with Headers and Base, put together by Hydraulic pressure without threads. The Sections are assembled with exra heavy Right and Left Nipples. The Headers and Bases are made interlocking which allows for close assembling and the staggering of all pipes in the completed Heater.

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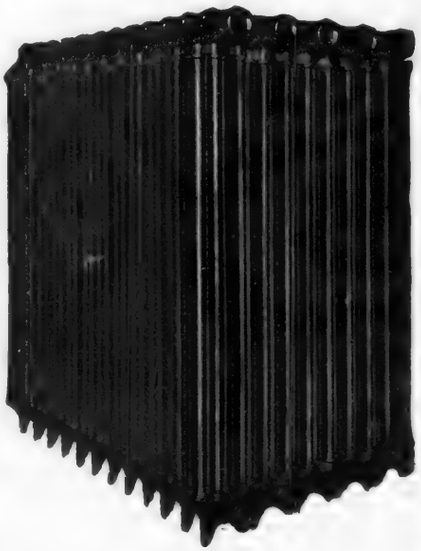
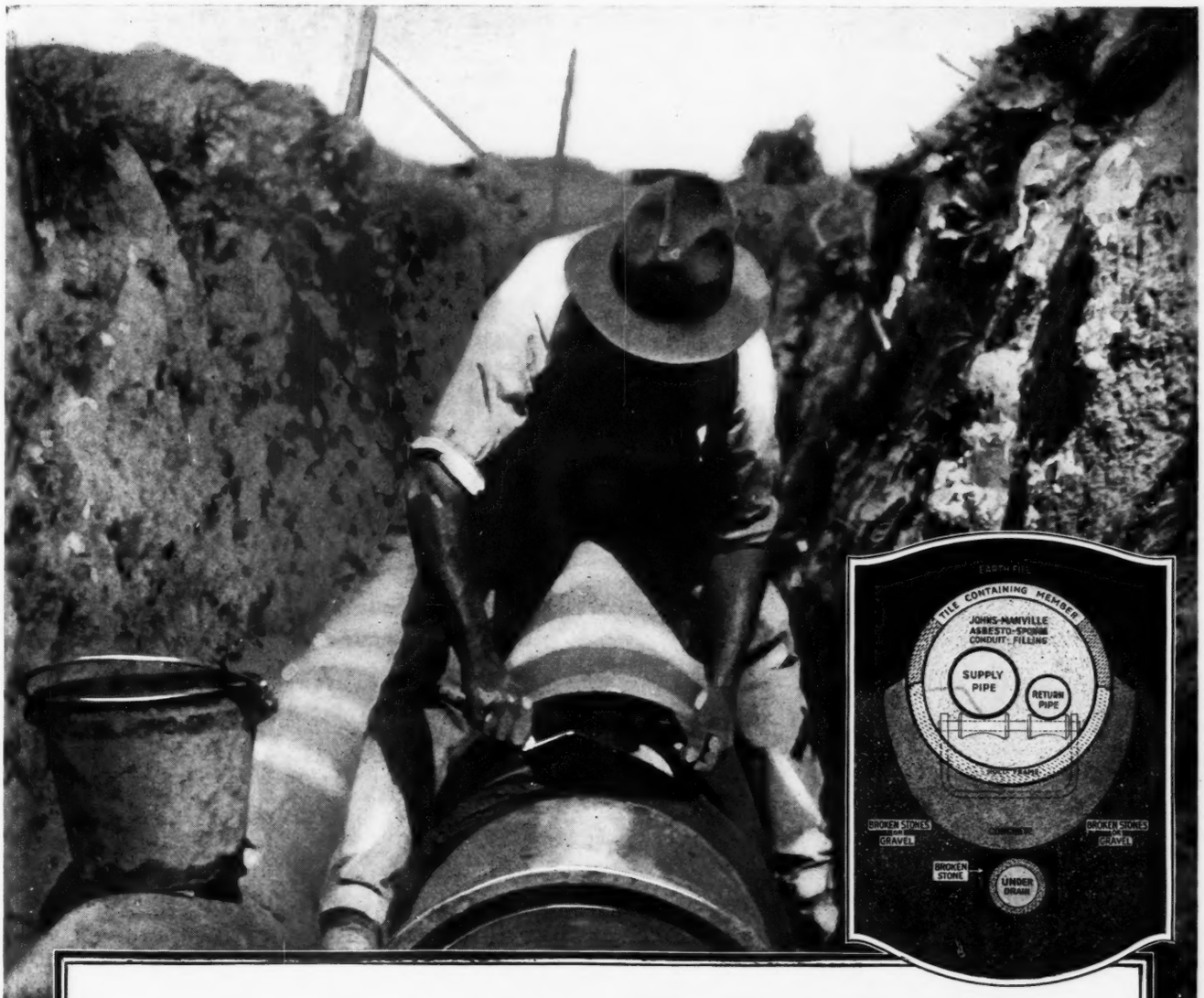


	Front View		These Heaters are made in the following sizes:						*Back View*	
Height	40″	50″	60″	70″	80″	90″	100″	110″	120″	130″	140″
Sq. Ft.	10.6	12.9	15.2	17.5	19.8	22.1	24.4	26.7	29.	31.3	33.6

LYON PRODUCTS COMPANY, Inc., *312-316 Union Park Court, CHICAGO, ILL.*



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Underground System of Insulation

Dutt, vice-president and David W. C. Rossett, secretary.

International Heater Co., Utica, N. Y., recently awarded prizes for the best discourse submitted on relative types of boilers. First prize, a Hamilton watch, was awarded to P. G. Langley, Langley Sales Co., Greensboro, N. C.; second prize, a traveling bag, was won by H. W. Swartwout, and third place, with a brief case as the award, went to F. R. Butters, of the company's engineering department.

Wolff Mfg. Corp., Chicago, Ill., announces the appointment as manager of its heating sales department of David H. Cuyler, formerly of the A. Z. Price Co., of Charlotte, N. C.

Central Station Heating Notes

Bronson, Mich.—The construction of a central heating plant to serve both the Kalamazoo State Hospital and the Western Michigan Normal school, to cost about $276,000, has been authorized by the State Administration board.

Cleveland, O.—The Cleveland Electric Illuminating Co., Cleveland, O., is to construct a huge central steam heating station near the lake front at Lakeside and Hamilton Avenues N. E. and East 20th Street. The station, according to the company, ultimately will have a capacity of 50,000 horsepower and will cost with main extension, approximately $3,500,000.

New York Steam Corporation, New York, is planning to enlarge its territory by connecting its steam distribution system to the power stations of the New York Edison Company. An agreement to this effect was made recently whereby the steam company will purchase from the Edison Company large quantities of steam for distribution in the Forty-second Street district, including Times Square and Grand Central Terminal sections. Additional stock of the New York Steam Corporation will be sold to finance the extension. Figures showing the expansion of the corporation's business, furnished by President James D. Hurd, show that for the calendar year 1921 the corporation sold 2,723,944,000 lbs. of steam; in 1922, 3,065,521,000 lbs.; in 1923, 3,660,885,000 lbs.; and for the twelve months ending May 21, 3,760,466,000 lbs.

PUBLIC SCHOOL No. 62, BRONX, New York City, N. Y.
Over one Hundred Lehigh Fans are installed in New York City Schools
Engineers—New York Board of Education.
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LEHIGH MULTIBLADE FANS

FOR HEATING AND VENTILATING

WHERE large volumes of air are to be handled at comparatively low pressures such as in heating and ventilating systems LEHIGH Multiblade Fans are guaranteed to be equal to, if not superior to, any other fans on the market.

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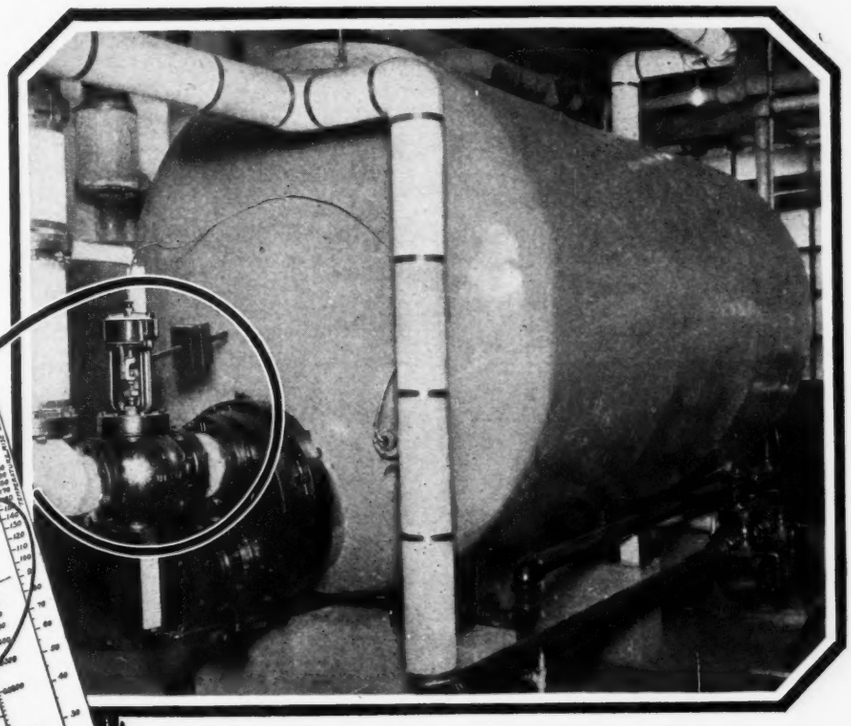
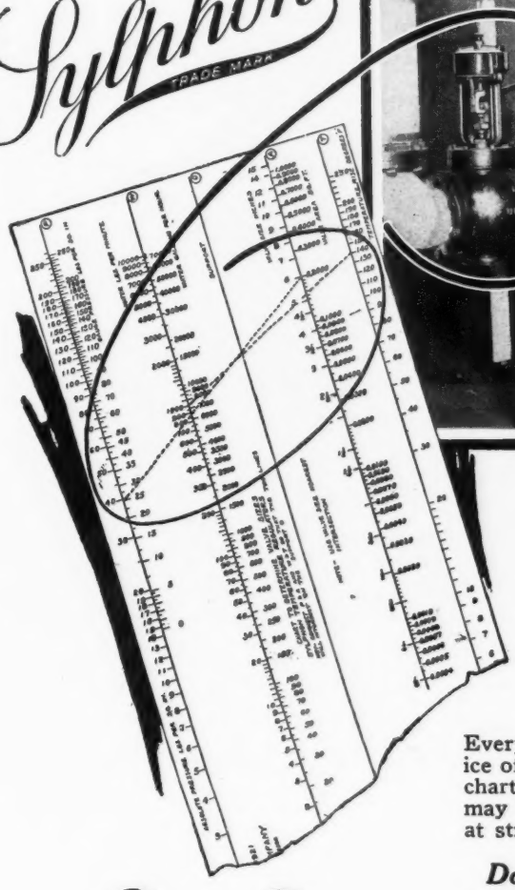
Illustration shows 6" No. 930 Sylphon Temperature Regulator installed on hot water storage tank in Stadium of University of Pennsylvania.

Architects: Day & Klauder Consulting Engineer: H. T. Campion Heating Contractors: Mechanical Equipment Co., Phila.

Sylphon TRADE MARK





Storage 4000 gallons, hourly heating capacity 7500 gallons, steam at 25 lbs.

Chart shows 6" valve size needed

Every heating engineer will recognize the efficiency and thorough service of The Fulton Company in compiling and distributing this valuable chart for determining valve sizes. You may have one—it's free, and may be obtained from any one of the 30 Fulton sales offices located at strategic points over the country.

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Sylphon Regulators are made in valve sizes ¼" to 8"

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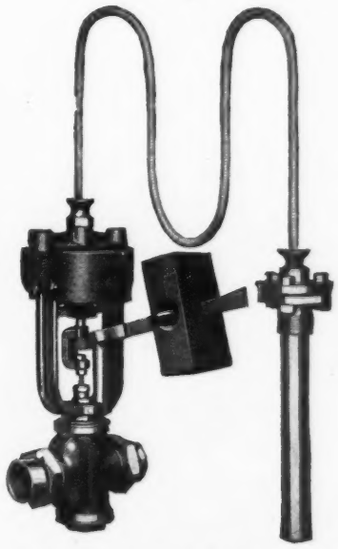
Ask for Bulletin and Chart WTR-103



No. 930 (lever type) Sylphon Temperature Regulator for Control of Liquids: Also No. 931 Spring type.

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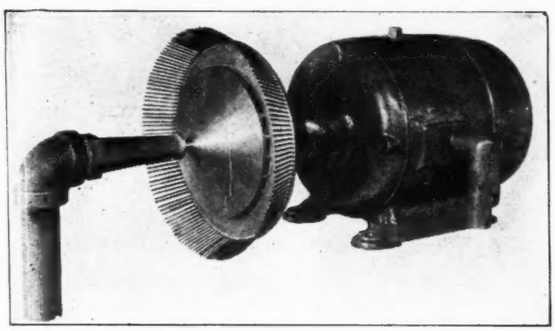

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